Journal of
MUSIC THEORY

A PUBLICATION OF THE YALE SCHOOL OF MUSIC

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ARTICLES

The Evolutionary Significance of 15th Century Cadential Formulae — *Robert W. Wienpahl*

Numerical Orders in Triadic Harmony — *Ian A. Morton*

The Harmonic Theories of Kirnberger and Marpurg — *Joyce Mekeel*

A New Method of Representing Tonal Relations — *Yehoshua Lakner*

BOOK REVIEWS

THEORY FORUM

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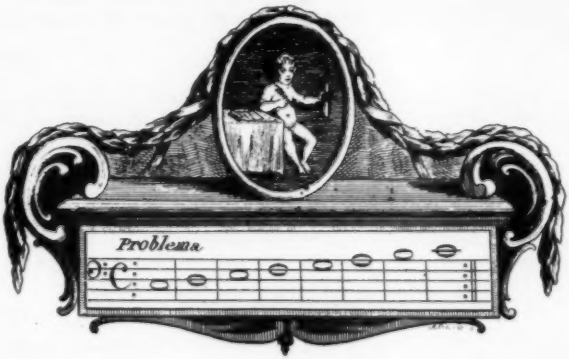

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YALE SCHOOL OF MUSIC

VOLUME IV NOVEMBER 1960 NUMBER 2

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The *Journal of Music Theory* is published in April and November by the Yale School of Music, New Haven, Connecticut.
One year: $4.50 Single issues and back issues: $2.50 Two years: $7.50

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THE EVOLUTIONARY SIGNIFICANCE OF 15TH CENTURY CADENTIAL FORMULAE

by

Robert W. Wienpahl
San Fernando Valley College

In seeking the factors most responsible for the gradual dissolution of the modal system we arrive of necessity at the harmonic considerations embodied in the final cadential formulae. The close was always considered the determiner of the mode -- this being a psychological necessity [29]. The approach to the close therefore is of primary importance; and since aesthetic considerations brought about numerous standardizations in this approach, composers and theorists were faced with the gradual unification of harmonic means which eventually were to be incorporated into a unified tonal system. Tonality is a vertical concept; modality is horizontal. Therefore we can understand the gradual evolution of the tonal medium most effectively through a survey of the harmonic trends depicted in the final cadence.

In order to arrive at some valid statistics, the author analyzed a large proportion of the available compositions of the 15th century, some 1728 items, representing the major western European countries from the early part of the century through the generation of Josquin [see Bibliography III for sources of this music.]. The results are incorporated into this study by means of percentages, the most efficient method for giving a true picture of evolution.

It must be noted at the outset that the theorists of that time, lacking the advantage of hindsight which we possess, had no terminology adequate to deal with the nascent harmony of the 15th century. It is true, nevertheless, that almost all writers on mensurable music discussed concords and discords, thus showing a preoccupation with vertical sound which was a concomitant feature of polyphonic music [e.g. 14, 68].

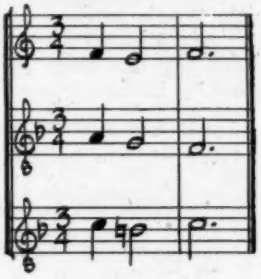
The church modes developed only in relation to unisonal singing. They were an established fact before the development of polyphonic music. The diversity of scale structure was easily possible when each mode was treated separately, and only slight adjustments were necessary to avoid the tritone as it arose melodically. But, as soon as two or more parts were combined, the vertical exigencies produced certain melodic changes which resulted in a relative amount of standardization, tending to break down the differences between the modes. It is possible, of course, to write polyphonic music in the pure modes if concord and discord are disregarded, as in modern music of certain types. But such was not the case in early polyphony. The older polyphonic composers were bound by an ever increasing body of restrictions which

fluctuated between the relative freedom of the 14th century, with its notated chromaticism, and the modal diatonicism of the late 15th century which made possible a unitonal conception.

Without a doubt, the largest single factor contributing to standardized vertical combinations is the final cadence. It made its first appearance in the rule governing only two voices in which the penultimate interval was to be either a major sixth leading to the octave final or a minor third leading to the unison. This rule was stated at least as early as the late 13th century by Anonymous XIII in the French treatise, Tractatus de discantu [3, 496]. In addition, he prescribes the major third, and the minor sixth, leading to the fifth. He also states that every good discant should begin and end with a unison, fifth, or octave [2, 497]. Such practices inevitably produced closes which sounded the same regardless of the particular mode in use.

Despite such well-stated rules, there are many examples in the early 15th century of peculiar cadence-structures which, since they are relatively isolated, can only be classified as rather crude. They merit little description; their peculiarities are noteworthy only as deviations from the norm. However, in general, it can be said that they were the result of an approach which was too polyphonic, or, on the other hand, that they arose from a lack of harmonic awareness, a lack which only makes the later rapid development the more significant.

One of the most common cadences of the late 14th and early 15th centuries is that involving the double leading-tone, a result of the above rules (Ex. 1[1]):

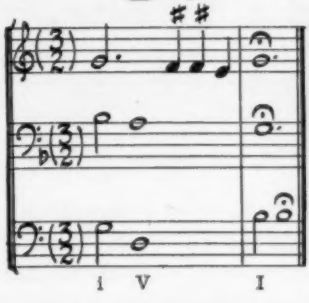
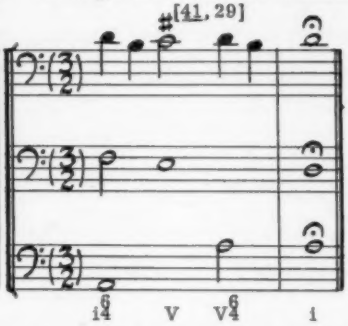
Example 1. de Lantins: Rondeau. [32, 76]

I_6 vii6 I

This cadential formula is diatonic only in the Lydian mode, but musica ficta was available to adjust the other modes -- either understood or expressly notated. As a horizontally conceived close it is most logical, and each part considered alone is very satisfying. It was

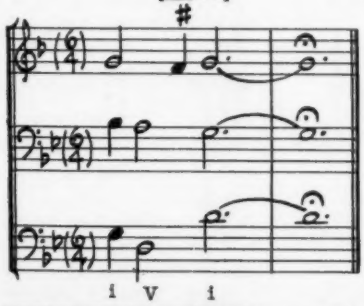
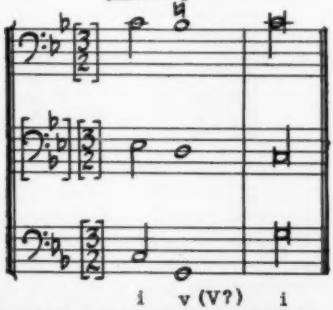
1. For all examples the author has supplied large Roman numerals to represent major chords, small Roman numerals to represent minor chords.

still used occasionally in the second Burgundian school. During the first half of the 15th century, it was prevalent in about 15% of the final cadences observed, naturally in an increasingly smaller quantity.

During this same period there existed also, and partly in conjunction with the above, the Landini, or ornamental-sixth cadence, in which the sixth degree is inserted between the leading-tone and the final octave close (Ex. 2). Example 3 presents an interesting variation of this.

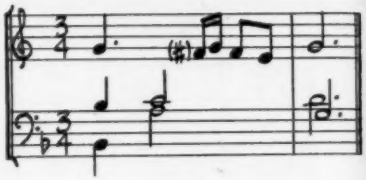
Example 2. Binchois: Chanson. [41, 39]

Example 3. Binchois: Chanson. [41, 29]

During the period 1400-1460 this feature was present in about 33% of all final cadence-structures, and could still be found not infrequently in the works of Josquin and his contemporaries.

Also at this time there developed a cadence-structure which foreshadowed the V - I bass progression of the authentic cadence.[2] It is the formula in which the contra-tenor leaps up an octave to the fifth of the final chord, while the tenor continues its downward progression from II to I; thus, a modification of the old basic scheme (Exx. 4 and 5).

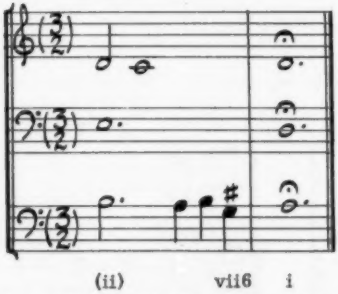
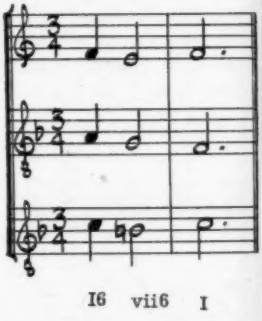
Example 4. Fontaine: Pastorale. [41, 12]

Example 5. de Lantins: Gloria. [51, 122]

2. In the examples the underscored V (V) indicates the leap of a fourth up or a fifth down to the tonic (not actually present here, since the cadence under discussion only foreshadows the true form).

This cadence is primarily a feature of the Burgundian period, during which time it occurred in 22.4% of all final cadences.

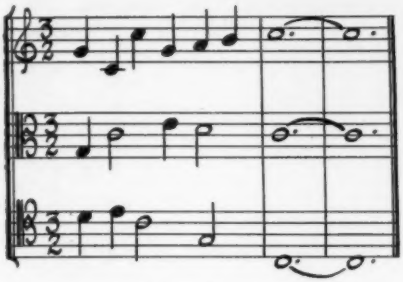
However, the most important cadential formula of the first half of the 15th century is the vii^{o}_{6} - I of vii_{6} - I. The degree symbol (^{o}) signifies the diminished fifth based on the leading-tone, a common feature of our major and melodic minor tonalities. Below is an example of this popular form (Ex. 6):

Example 6. Dunstable: Chanson. [47, 30]

Its popularity is confirmed by the fact that about 30% of all final cadences in the first half of the 15th century followed it. Its use of the leading-tone is mandatory, of course.

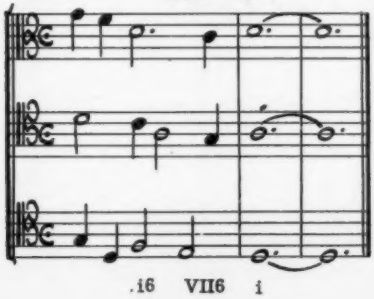
The next most frequently employed form, vii_{6} - I, shows about a 20% usage (Exx. 7 and 8):

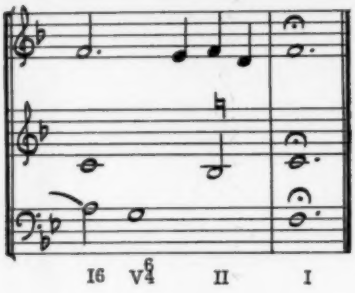
Example 7. Grenon:Chanson. [41, 4]

Example 8. de Lantins: Rondeau. [32, 76]

This is a significant formula because it has two possible implications: either it produces the double leading-tone, or it gives way to the Phrygian cadence, which is the only possible form of vii_{6} - I in that mode. The Aeolian mode also lends itself very easily to the Phrygian cadence. We have already noted that about 15% of the cadences featured the double leading-tone; approximately 4% made use of the Phrygian close, that is, 4% of the complete total rather than of the division within vii_{6} - I cadences.

The important dominant to tonic cadence with the leap of the fourth upward or fifth downward in the bass, the nascent authentic scheme, accounts for about 17% of all cadences in the first half of the 15th century (Ex. 9). Half of these fall within the second Burgundian period, showing that the V-I bass progression occurred much less often in the early decades of the 15th century.

Example 9. Dufay: Chanson. [48, 140]

Of the remaining 8.5%, two-thirds derive from a single German source, the Glogauer Liederbuch, and about one-sixth from the English continental composers who are well-known for their advancement over their conservative insular brethren. The early Italian sources are very limited and show no use of the dominant-tonic cadence. And the early Spanish sources are, at present, unavailable.

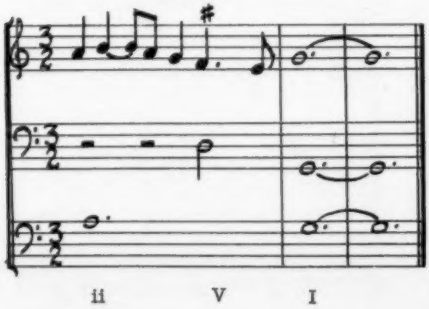
These are the most common forms of cadences in the first half of the 15th century. There remain some other types which are noteworthy only because they are deviations. The major VII_6 - I is almost entirely limited to this period and primarily to the English insular composers, although it occurs to some extent in the English continental sources. It is most easily available in the Dorian, Aeolian, and Ionian modes, and precludes the use of the leading-tone. Of the total of final cadence patterns it occupies slightly less than 2%, an appreciable amount, nevertheless (Ex. 10).

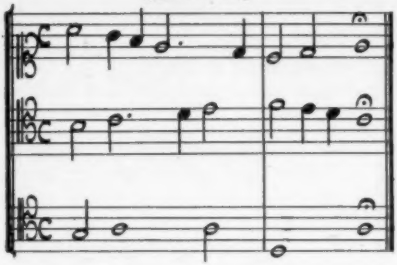
Example 10. Benet: Agnus Dei. [38, 126]

A cadence of similarly frequent occurrence is the ii or ii_6 or II - I. It is still met with occasionally as late as the last generation of the Flemish school (Ex. 11):

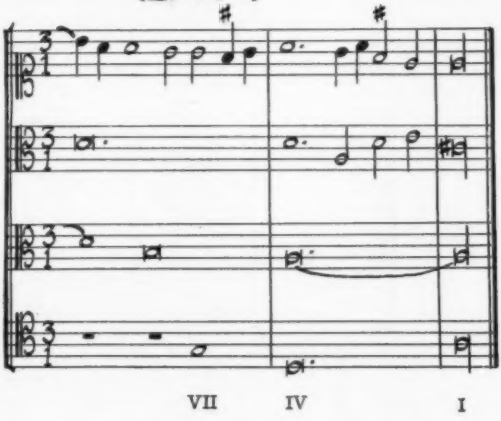
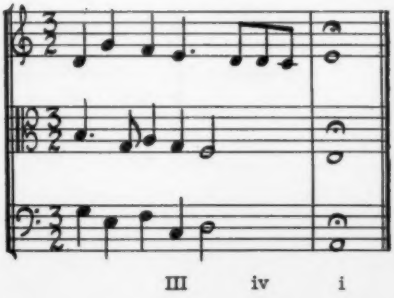
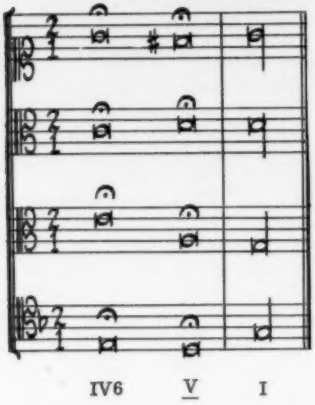
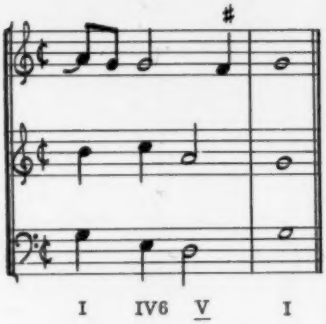
Example 11. Vide: Chanson. [41, 21]

It is interesting to note that the iv or IV - I close, the plagal cadence, is present only as an isolated phenomenon, one instance occurring in the second Burgundian school, one possibly in the work of Dunstable, and four in the Glogauer Liederbuch (Exx. 12, 13, and 14, p. 137).

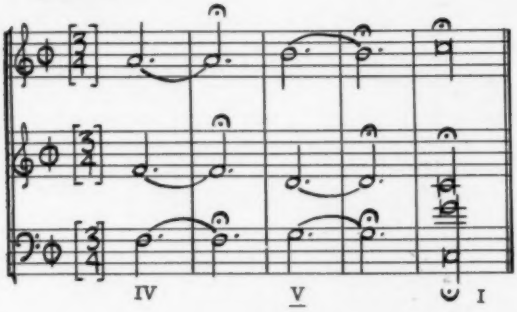
As to examples of the authentic cadence, IV - V - I, during this period, there were only seven noted out of a total of 717 final cadences examined, extending into the second Burgundian generation of Dufay and his contemporaries. Five of these were from this Burgundian group (Ex. 15, p. 138), one from a German Lied (Ex. 16, p. 138), and one from an early Italian source (Ex. 17, p. 138). There is also an interesting variant which lacks the dominant-tonic progression in the bass (Ex. 18, p. 138).

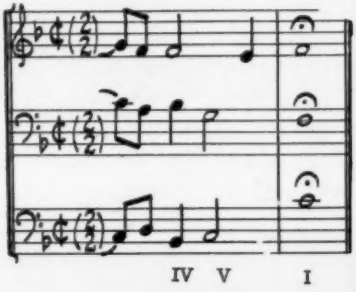
Of the other close, ii - V - I, there is only one example (Ex. 19):

Example 19. Dunstable: "Beata Mater." [49, 96]

Example 12. Anonymous: "O Rosa Bella," Sanctus. [33, XI, 23]



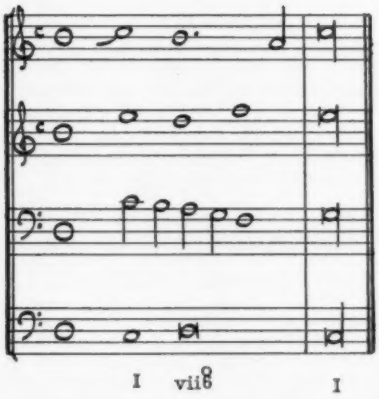
Example 13. Dufay: Missa "Caput," Agnus I. [32, XIX, 43]

Example 14. [46, 22]

Example 15. Binchois: Gloria.
[33, XXXI, 55]

Example 16. Anonymous: Chanson.
[31, 45, 16]

Example 17. Faragti: Motet.
[51, 252]



Example 18. Hayne: Chanson.
[41, 110]

Thus, it can be seen that there were only a few tentative attempts in the early 15th century toward anything resembling a true tonal cadence. If the authentic cadence had not continued to develop in the ensuing period, one would treat these few manifestations as mere happenstance. However, the importance of the development of the dominant-tonic progression in the bass should not be overlooked and the frequency of its occurrence, particularly in the second generation of the Burgundian school, verifies its significance, especially in relation to the predominant use of the leading-tone.

Further, the dominant-tonic progression in the bass facilitated the gradual change from three-voice to four-voice structure. An examination of the same body of works, through the second generation of the Burgundian school, shows that approximately 14% were in four, or more rarely in five or six voices, a figure that compares rather favorably with the 17% which used the dominant-tonic bass progression in the final cadence. The remaining 86% are, of course, predominantly three-voice works, with a small percentage of two-voice works.

A final point remains to be discussed in connection with the cadence problem: the use of the third in the tonic chord. Here again the infinitesimal manifestation is interesting only insofar as it illustrates a tentative groping in the direction of a fuller sonority. This is shown in Ex. 20 below.

Example 20. Leonel: Sanctus.
[45, III, 75]

Approximately 3% of the cadences included the third in the final chord. Of these 1.9% were in sacred works; the remaining 1.1% were in secular works. This difference is noteworthy because in the latter half of the 15th century, to be discussed below, the situation is reversed: the secular works use the third far more often.

The second half of the 15th century presents quite a remarkable evolution. Those factors enumerated above which represented only tentative gropings in the field of harmony suddenly seem to burst forth with a new effulgence. So powerful was the influence of the second generation Burgundians upon the following half-century that it seemingly caused a renaissance in the almost dormant field of music theory. From the time of Ugolino and Prosdocimus in the first quarter of the century until Tinctoris and Gulielmus Monachus at the beginning of the final quarter of the century there were practically no theorists of note. In the ensuing fifty years a profound change had taken place.

Johannes Tinctoris is one of the first to take note of the change. In the Prohemium to his Proportionale musices (ca. 1475), after duly complimenting the King of Naples, he states:

> Thus it happens that at this time the capacity of our music has increased so wonderfully that a new art may be seen to exist whose source and origin, if I may refer to it so, was considered to have been among the English, of whom Dunstable appeared chief; and contemporaneous to him there were in France Dufay and Binchois, to whom immediately succeeded the moderns, Okeghem, Busnois, Regis, and Caron, all of whom may be heard in very excellent compositions. To them the English, who are commonly said to shout while the French sing, cannot compare. For indeed, the French invent the newest songs for these new times, while the English continue to compose in the same style, a miserable indication of talent [20, 154].

Thus, while he gives credit to the English for the origin of the new art, he makes it very clear that they failed to advance, and merely continued to compose in the same way, "a miserable indication of talent." On the other hand, he considered the French to be truly inventive. Tinctoris showed great perspicacity, for such was actually the case, the English falling by the wayside until the end of the century.

A like testimony was issued by an unknown Spanish monk in a treatise entitled Musica de canto llano y de organo:

> Thus, there is a science of composing, as of singing and playing, which I doubt future composers can advance farther than touching upon these three things; to compose, to sing, and to play upon all the instruments of the world. Since I do not find anything new in their inventions, I doubt that they can as subtly compose or sing a contrapuntal composition as those very learned and extraordinary persons, Dunstable, Dufay, Johannes Okeghem, master of the chapel of the King of France, Binchois, Constans, Busnois, Guillelmus, Faugues, Henricus, Pul-

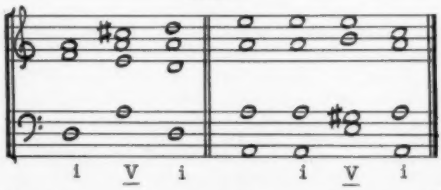
> lois, Johannes Urrede, Johannes Martini, and many others, who at this time make music blossom so well, who have illuminated and purified it more in the forty years just past and the forty to come, than in all the 1440 years since the birth of Jesus Christ [2, 65].

The only real difference between the anonymous Spaniard and Tinctoris is that the former displays little hope for the future of music.

Of more direct concern is the analytical approach to the problem of vertical harmonic combinations. Perhaps the greatest advance in this direction was made by Gulielmus Monachus in his De preceptis artis musice et practice compendiosus libellus, which, according to Machabey [15], probably dates from around 1480. In this treatise, in addition to treating the rules of counterpoint of the English, fauxbourdon (of which more later), and gymel, he shows a profound interest in cadence-structures, giving the following rules:

> And a note, therefore, concerning composition in four voices, or with four voices above whatever cantus firmus, or above whatever measured cantus you may make, wherein the contra-tenor bass always holds a fifth below [the tenor] in the penultimate chord. Likewise therefore in the antepenult it may be a third below, and ... in the last chord at the unison or octave below. The soprano, indeed, always keeps at the sixth above the tenor in the penultimate chord, and so in the final chord it may always be an octave above the tenor. And in like manner in the first note it may be an octave; in the remaining notes, however, they may be at the sixth. On the contrary the altus always makes a fourth above the tenor in the penultimate chord, and therefore in the antepenult it may be a third above, ... and therefore in the final it may always be at the third, above or at the unison or at the octave below... [12, 295].

These rules result in the following cadences (Ex. 21):

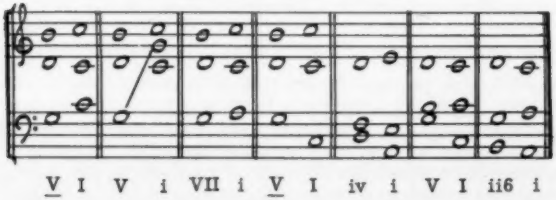
Example 21. Gulielmus Monachus [12].

Notice that the penultimate sixth is made major (or the penultimate third minor) according to the rule well established over two centuries before. (See the reference to Anonymous XIII on p. 132). It also makes very clear the dominant-tonic bass progression, which was now used in almost the majority of final cadences, as will be pointed out. The rules also authorize the use of the third in the final chord, a rather advanced acknowledgement, since only in the last decade of the

15th century did such a feature become quite common.

Another set of rules was given by Franchinus Gafurius in 1496. They are similar to those stated above, although they show a less advanced conception in a number of respects. He treats only the three-voice structure, is concerned only with the last two chords of the final cadence, and includes the VII or vii_6 - i close which by now is almost archaic. However, he does specifically mention the iv - i (plagal) cadence which, as will be indicated, occupied a not unimportant place in the late 15th century. His rules, then, are as follows:

> Concerning the conclusions of songs. When we seek a perfect concord from an imperfect concord, just as the end of a song or any of its parts, then always in the penultimate the discant remains at the sixth above the tenor and proceeding in contrary motion (the tenor descending one tone as the other ascends) they end at the octave. And in the penultimate the contratenor ought to stand at the fifth below the tenor, and hence a tenth from the discant. But in the final chord it will be able to occupy the unison with the tenor [a] or the fifth above the tenor [b]; likewise it may be disposed at the third below the tenor and then it will sound at the tenth with the discant [c]; however, it will not be done in this way in all the voices at the close (for as I have said one ought not to attribute perfection to the beginning but to the end); nevertheless, it will remain agreeable at the octave below the tenor [d]. Indeed, if the tenor closes on mi, in the penultimate the contratenor ought to be placed at the third below the tenor and the discant remaining at the sixth above the tenor; thus in the final the contratenor will be placed at the fifth below the tenor descending by a fourth by the syllables sol re [e]. If, however, the tenor assumes the discant pattern, the discant may take the species of the tenor, going up and down with the tenor; or from the third to the unison, the contratenor standing in the penultimate at the third below the tenor [f]; or from the fifth to the third, so that the contratenor with the tenor forms a sixth going to an octave, and moves in tenths with the discant [g] [9, fol.17].

Below are the realizations of these rules as referred to by the bracketed letters (Ex. 22):

Example 22. Gafurius [9].

And in 1517 Andreas Ornithoparcus gave ten rules for closes, as follows:

> First, Every Close consists of three Notes, the last, the last save one, and the last save two.
>
> 2 The Close of the Discantus made with three Notes, shall alwayes have the last upward.
>
> 3 The Close of the Tenor, doth also consist of three Notes, the last always descending.
>
> 4 The Close of the base requires the last Note sometime above, and sometime beneath the Tenor. Yet commonly it thrusts it an eight below, and sometimes raiseth it a fift above.
>
> 5 The Close of a high Tenor, doth sometime rise, sometime fall with the last Note; sometime makes it an Unison with others. Which being it proceeds by divers motions, the sorting of it is at the pleasure of the Composers.
>
> 6 The Close of the Discantus, doth require the last Note save one above the Tenor in a sixt: or in a fift, if the Base hold a sixt below.
>
> 7 The Last Note save one of a Tenor, is flatly placed a fift above the Base and a sixt also, if the Base take the Close of the Tenor, and the Tenor the Close of the Discantus.
>
> 8 If the Close of the Tenor end in mi, as it is in the Deutero, or otherwise the last Note but one of the base being placed not in the fift. But in the third beneath the Tenor, may fall upon the fift Finall without any hazard of Descant, as is declared in the under-written Concent.
>
> 9 If the Close of the Tenor end in re, as commonly it doth in the first Tone, the Base shall very finely end from a fift to a third upward, not varying the Discantus, although it may also fall into an eight.
>
> 10 Every Song is so much the sweeter, by how much the fuller it is of formall Closes. For such force there is in Closes, that it maketh Discords become Concords for perfection sake. Therefore let Students labour to fill their Songs with formall Closes. Now that they may the more easily doe this, we thought fit here to set downe an Exercise or Store-house of Closes, that such as Students sing here, they may know they are in their owne Songs to make [17, 84].

It will be noticed that in Rule 7 he states: "the last note save one of a tenor, is placed flatly above the Base..." And further on he remarks: "Contrarily if you make your Base first you shall make it with the dis-

cantus." This is perhaps the earliest reference to calculating an interval from the bass. However, it does not affect the real hegemony of the tenor in contemporary theoretical thought, for the tenor voice is established first, all other intervals being figured from that part; the bass is not yet the fundament of the harmony. Not until seventy years later was it recognized, partially, by Adrian Petit Coclicus [8] and, more fully, by Zarlino when he likened the bass to Earth, tenor to Water, alto to Air, and soprano to Fire [24]. Even as late as 1547, Glareanus still regarded the tenor as the first part invented: "The tenor is called the thread of the theme, and the first voice invented, to which the other voices usually pay respect, and to which all are ordered [11, 240; cf. 23, 77]." The word "usually" may indicate a break in his strict dictum.

In the same treatises tables of consonances provide another sign of greater preoccupation with the vertical distribution of notes. Actually, the early 14th century saw the first treatment of intervals apart from voice-leading, in the treatise Ars discantus by Johannes de Muris [14, 68] or in Odington's inclusion of the third as middle note of the interval of a fifth in his De speculatio musicae [16, 202].

However, true tables of consonances are not found until the late 15th century. Tinctoris gives a complete treatment of concords and discords in his Liber de arte contrapuncti [19, 76], as do Gulielmus Monachus [12, 290], Ramis [18], Hothby [13, 333], Burtius [7], and Gafurius [9]. Although it is not the purpose of this study to discuss the various rules, it is significant that they were promulgated just as chordal passages came to be used more freely in music which otherwise was conceived polyphonically [27].

This brings us to the problem of the possible origin of such chordal passages. There seems to be little doubt that the entering wedge was the practice of fauxbourdon, that succession of first-inversion chords which reduced the importance of individual voice-leading, making two parts subordinate to the third, and bringing with it a feeling of vertical sonority which is primarily harmonic. The earliest reference to the term fauxbourdon is in Codex 37 of the Liceo Musicale in Bologna, a manuscript which dates from sometime between 1430-40), although the actual practice to which it refers is very much earlier. While its origin is not entirely clear, the evidence at present seems to point to England, to the style which Bukofzer calls "English discant [5].[3] It seems reasonable to suppose that the $\frac{6}{3}$ chord style was an outgrowth of the English practice of gymel, an Anglicized version of cantus gemellus, (twin song), a method of singing in two parts in parallel thirds or sixths. It dictated much of English harmony in the 14th century [26], although it probably originated in the 13th century. Simon Tunstede, in his Quatuor principalia (1351) stated: "Moreover it should be noted that in neither Rome nor France do they ascend in sixths against the plainsong, unless it be rarely [21, 23b]." This would seem to imply a specifically English practice.

As to the actual rules for English discant, they are set forth in

3. Cf. Sylvia Kenney's "English Discant and Discant in England" [The Musical Quarterly, XLV (1959)], which appeared after the present article had been completed [Ed.].

three treatises in the English language, a fact which attests to the popularity of the practice. Three of them are to be found in the Lansdowne MS 763, viz. one by Leonel Power, one anonymous, and one now called pseudo-Chilston [5;28;10]. There is also an anonymous Latin tract in the British Museum (MSS Add. 21455) [5;10], the probable date of which is sometime during the second quarter of the 15th century. These works make it clear that English discant is an improvisatory form of singing from an original cantus firmus by means of a "sight" system, either in three parts (for tenor, mene, and treble) or in four (by addition of the quatreble). In this system the mene and treble begin a fifth and an octave above the tenor and then imagine that they are singing a third below it. Thus, with the exception of the beginning and ending of phrases, at which point they maintain the true octave and fifth above, the mene actually sounds a third above and the treble a sixth above, yielding a succession of parallel $\frac{6}{3}$ chords. In order to break the monotony, the treble and mene were to ornament their parts.

On the other hand, fauxbourdon, while it undoubtedly grew out of the English practice, was created in an entirely different manner. During the 14th century the French had become accustomed to placing the melody of the secular chanson in the upper part and to making of the two lower parts a sort of instrumental support. This practice was carried over into the ballade-mass of the 14th century with the cantus firmus in the treble [25; 22]. With this predilection the French, or Burgundians, notated the two outer voices, the cantus firmus being transposed up an octave, and the contratenor starting and ending each phrase at the lower octave, but otherwise moving at the sixth below. The term fauxbourdon indicated that the middle part was to be extemporized at sight at the fourth below the soprano.

With both methods, therefore, the results are the same; but with the English method the cantus is in the tenor and in the French in the soprano [5]. Thus, it would seem that the fauxbourdon practice actually made the melody in the soprano the important part, with the result that the final addition of a true bass part brought with it a more harmonic effect than did the English discant, in which the tenor was already a set part.[4] Fauxbourdon would allow more harmonic freedom. As a matter of fact, this was actually the case, for the Burgundians quickly took over the lead in music from the English to whom, nevertheless, we must not fail to give credit for the original practice of parallel $\frac{6}{3}$ chords. This may be what Tinctoris meant when he spoke of the new art which had its source and origin among the English (see p. 140). At any rate, the practice of fauxbourdon eventually spread to England, completing the circle of evolution. In this respect, Dunstable shows the influence of Dufay, for there are passages in his Ave Maris Stella which are in fauxbourdon style [52, 36]. His more conservative insular brethren were to resist the change for some time to come.

That the whole practice of fauxbourdon was of considerable im-

4. Georgiades considers the former "... a continental variant of the latter," and therefore believes that the English are entirely responsible for the development of a "... new harmonic-contrapuntal technic." [10, 105 and 111].

portance is substantiated by the writings of the late 15th-century theorists. Tinctoris refers to it in his Liber de arte contrapuncti when speaking of the interval of a fourth, as follows: "Furthermore in all the discourse of the cantus which they call fau bourdon, only the fourth is admitted ... [19, 85]." Gulielmus Monachus has this to say in his De preceptis artis musice (ca. 1480), under the heading Regule contrapuncti Anglicorum:

> Here begin the rules of the English counterpoint, which the English themselves practice in the following two ways. The first way, which is common among them is called Faulxbordon. This Faulxbordon is sung in three parts: the tenor, contratenor, and soprano. The second way, indeed, which is called Gymel, is sung in two parts: the soprano and tenor [12, 292b].

He then gives rules for both. These rules are not at all clear as to the position of the cantus firmus, but would seem to imply that it lay in the lowest part [12, 288b]. Once again, we are less interested in his rules than in the attention he devotes to the subject and his recognition of it as an English practice.

Adam de Fulda also mentions it in his Musica (1490) in speaking of the use of the interval of a fourth as a consonance, as follows:

> ... and it is made consonant, not from itself, but in respect to other things; wherein they begin to call music of a certain kind by the name Faulxbordon, because it gives out the sound of a fourth [1, 352].

Gafurius speaks of the consonant fourth in this same fashion:

> ... in the middle the contratenor is often followed by the notes of the melody, proceeding at the fourth below this same melody... contrapuntal songs in this manner they call 'in Faulxbordon' [9].

Four of the above authors are preoccupied with the treatment of dissonance and consonance, and they find that harmonic considerations already are taking precedence over polyphonic rules.

Having thus set the stage for the latter half of the 15th century, we shall now continue with the practical treatment of cadence formulae, examining the works of the third generation of the Burgundian school, the first and second generations of Flemish composers, the late English, insular and continental, and the late Spanish, Italian, and German composers. Although this carries us into the first two decades of the 16th century, these men are products of the 15th century and produced the major portion of their works under 15th-century influences -- which is also true of this same group of theorists. In this part of the article we shall make various references to the earlier part, which is devoted to the cadences of the first half of the century. Thus, the order of treatment remains the same, permitting the trends to be followed more easily.

The double leading-tone which is so irrevocably tied to the purely polyphonic close, and which was present in 15% of the cadences during the first half of the century (most particularly in the early works) now is not to be found at all. It will be remembered that it was still occasionally used by the second generation of Burgundians.

The ornamental sixth (Landini sixth), formerly present in one-third of all final cadences, is now found in only about 5%.

These two features, the double leading-tone and the ornamental sixth, are notable for two very different reasons. The former is purely polyphonic and gave way to the more harmonically conceived leading-tone in only one voice, while the latter avoided the full implications of the leading-tone by ornamenting it. The trend away from the notated chromaticism of the 14th century was probably responsible for this, since that feature tended to allay the feeling of the raised seventh which was being supplied by musica ficta in derogation of the purity of the church modes.

The cadence structure V - I without the dominant-tonic progression in the bass (due to the ascending octave-leap by the contratenor), a forerunner of the authentic cadence, was present in 22.4% of the works of the first half-century (primarily the Burgundian period). It has now dropped to 8%. Obviously this was a gradual change and was probably due to the increase in the number of voices from three to four or more in the latter half of the century, which made a true bass possible.

As noted above, the three-voice compositions (and a small percentage of two-voice compositions) were used in 86.5% of the works of the first half of the century, the remaining 13.5% being four-voice, primarily an innovation of the second-generation Burgundians. During the ensuing half-century this ratio almost reversed itself; 70% are now in four or more voices, while the remaining 30% are in three voices or occasionally two.

The most important cadence formula of the first half of the century was the vii^{o}_{6} - I, with its characteristic use of the leading-tone. During that period it was present in 30% of all final closes, but during the last half its use had dropped to 5.6%. And the second most popular, the vii_{6} - I, has dropped from 20% to 5.4%. In short, these two forms, which accounted for a total of 50% of all final closes, had now dropped to 11%. This is a result of the growing importance of the dominant-tonic bass progression with the increase to four-voice structure.

It was noted above that the vii_{6} - I close has two implications: either it produces the double leading-note, no examples of which were found in the later 15th century, or it produces the Phrygian cadence, a feature of the Phrygian mode which is also readily available in the Aeolian mode. In the first period approximately 4% of all closes were Phrygian; in the last period this has increased to 5.4%, due to the complete avoidance of the double leading-tone. Under purely modal conditions, it might have increased even more, but the growth of the harmonic dominant-tonic structure precluded this.

As to the all-important V - I cadence involving the dominant-tonic bass progression, the first half of the century showed only 17% usage in all final closes, of which half were in the works of the second-generation Burgundians -- still a small percentage. However, in the second half of the century this amount gradually increased until 65% of all the works closed with this significant formula.

Once again, the reason for this lies at least partially in the change from a three- to a four-voice structure. But there is a much more important basic concept: the gradual and probably almost unconscious change from a primarily polyphonic conception to one which is influenced by harmonic considerations. The purely polyphonic approach to the final close is much more likely to be stepwise, notwithstanding the embellishment of the ornamental sixth. This resulted in the popularity of the vii^{8}_{6}, vii_{6}, VII_{6}, ii, ii_{6}, or II_{6} - I close which accounted for almost 54% of all cadences during the first half of the century. However, it accounted for only 12.5% of those in the last half.

This brings us to the question of the other important form involving a true harmonic leap in the bass, the iv or IV - I (plagal) cadence, which was almost entirely missing in the first period, only five cases, or .6%, having been found. In the second period almost 14% of the compositions cadenced in this fashion. Of these 10.1% were minor subdominants (iv - I) and 3.7% were major subdominants (IV - I).

The predominance of the minor subdominant is undoubtedly due to the fact that polyphonically it produces a descending leading-tone to the fifth of the tonic final. This is most satisfactory. Furthermore, it is the accepted form in our modern minor key, and during the latter half of the 15th century the "minor" mode endings predominated over the "major" by about three-to-two.

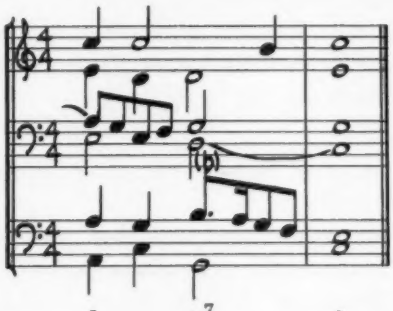
These two forms, then, the dominant-tonic and the subdominant-tonic, account for 78% of all closes in the last half of the 15th century, compared with 22% for the same combination in the first half of the century, a most significant advance. Such a strong leap in the bass at the final close is definitely a harmonic manifestation which, coupled with the rules of the theorists, shows the trend away from music which is conceived purely polyphonically.

However, there is still a very great difference between a harmonic manifestation of this kind during the modal period and the true tonal quality of the authentic cadence, of which the dominant-tonic progression in the bass is only a part. Of the 65% of cadences involving this bass progression only 14.1% use the authentic cadence iv or IV - $\underline{V}$ - I. Another 1.6% use the ii - $\underline{V}$ - I. And only 1.5% employ that interesting harmonic variation, the I^{6}_{4} - V - I. In short, the real tonal cadence, while no longer an isolated phenomenon, still is not used sufficiently to enable one to call it a characteristic feature of modal music. Its occurrence is significant only as an early implication of tonality.

Finally, we come to consider the inclusion of the third in the tonic chord. During the first half of the century it was present in only 3% of all compositions; but in the latter half of the century it was pres-

ent in 39% of all final tonic chords. Its greatest increase, of course, occurred during the time of the second-generation Flemish composers. It is noteworthy that it was used very much more in secular works, viz. 28.7%. This probably is due to the wider separation between sacred and secular works as the church began to make greater demands for purity in ecclesiastical compositions, a purity which would be better expressed through the final open fifth -- a return to the past.

It should be remarked that the presence of the third in the final chord makes the use of the passing dominant-seventh considerably more obvious, thereby putting in place another stone of the harmonic arch [6, 187n] (Ex. 23).

Example 23. Anonymous. St. Matthew Passion. [6, 186]

In addition to the above cadence formulae there were, of course, numerous and strange digressions, for example, II - VI - I. Some of these may have been experimental, but since they did not develop further their historical import can be regarded as minimal. However, 2.5% of all cadences during this last period were taken up by such oddities -- a not inconsiderable amount.

There is one outstanding feature in the whole problem of chordal structure in the late 15th century: the reluctance of the theorists to consider the bass as the primary determinant of the harmony. There is no evidence that contemporary writers were aware of a chord as such, but rather they were primarily interested in reckoning intervals above and below the tenor. And, of course, since they had no conception of the chord as an entity, they had no thought of its invertibility, an idea which required another one hundred fifty years to emerge.

This undoubtedly presents the greatest difference between modality and tonality. Whereas tonality is based primarily upon a succession of chords, of which three are the bearers of both the harmonic and melodic design, i.e., the tonic, dominant, and subdominant, modality is based essentially upon a scale-system in which the tonic is normally regarded as the beginning and ending note, and the dominant as a secondary point around which the diapente and diatessaron species

of that scale circulate. As we have seen, however, certain elements of tonality were gradually evolving in what was in the 15th century still essentially a modal system. Thus, the confluence of voices at the close was slowly producing a more harmonic feeling by progressive emphasis upon the three primary chords.

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NUMERICAL ORDERS IN TRIADIC HARMONY

by

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During the past several years I have been experimenting with numerically ordered tones, aided by an instrument developed for that purpose, an instrument which I call the Synchronized Tone Generator. This electronic device is capable of producing a large number of extremely precise, automatically tuned, numerically ordered pitches in an interlace of simple 1-3-5 relationships. (An experimental model of the instrument is described below following a discussion of the theoretical considerations which led to its design.)

The underlying principle for this experimental work has been the idea that musical pitches may be related as the functions 1, 3, 5, 1/1, 1/3, 1/5, their multiples and submultiples. The word "function" as it will be used in this article refers to the numerical relation of one tone to another without regard to the octave in which it appears. Inversion therefore has no meaning within the scope of this definition. The function 1 describes the unison or any of its octave equivalents in either direction; the function 3 denotes the perfect fifth above a tone, e.g. G in any octave when related to C; the function 5 denotes the major third above a tone, e.g. E in any octave when related to C; the function 1/1 denotes the unison or any of its octave equivalents; the function 1/3 denotes the perfect fifth below a tone, e.g. F in any octave when related to C; the function 1/5 denotes the major third below a tone, e.g. any A^{b} when related to C. The functions 1, 3, and 5 are integral primes: whole numbers which cannot be divided by other integrals without leaving a remainder except when divided by themselves or by 1. The numbers 1/1, 1/3, and 1/5 are reciprocal primes: fractions which cannot be divided by reciprocals without leaving a remainder except when divided by themselves or 1/1. Integral and reciprocal prime numbers are basic to any study of numerical relationships.

Thus, in the simplest terms, this means that pitch organization as we have known it in Western culture is a result of frequency multiplication and division on a 1-3-5 base. The fact that these relations have been rounded off in equal temperament does not invalidate the notion, since the mind seeks constantly to resolve the complex tempered ratios into simple terms. This should not be construed to mean, however, that the ear is incapable of very fine pitch discrimination. Consecutively played tones separated only by a Pythagorean comma are readily distinguished; and, of course, simultaneously played simple relationships mistuned by even a hair's breadth produce easily detected beats.

It is important to note that the first three integral primes, 1, 3,

and 5, form the major triad (e.g. C-G-E), and the first three reciprocal primes, 1/1, 1/3, 1/5, form the minor triad (e.g. C-F-A^b). These are primitive and singularly unique tonal units in the music of our culture. Their uniqueness lies in the fact that when either the integral set or the reciprocal set is complete it fully defines a root and indicates the character of the sonority as integral or reciprocal; when incomplete, the number 1 of the set remains indeterminate and the character of the chord ambiguous. Thus, open fifths, isolated major or minor thirds, "fourth chords," "whole-tone chords," "diminished sevenths," etc., remain ambiguous because their internal relationships fail to indicate whether the tones are the result of multiplication or division. Additional prime functions such as 7, 11, 13, or 1/7, 1/11, 1/13 add nothing to the information provided by the first three integral or reciprocal primes.

The suggestion in this day and age that the minor triad is obtained by frequency division, resulting in a structure disposed downward from a tone traditionally called the fifth of the triad invokes the shades of countless theoreticians of the past three centuries. It is also likely to evoke the laughter of a similar number of contemporary theoreticians. To give cheer to the shades and perhaps allay some of the laughter let it be pointed out that the Synchronized Tone Generator, a very real piece of hardware, is capable only of producing tones related to one another in the order of the subharmonic series. Like the valveless horn, which can play only tones related in the order of the harmonic series, this instrument plays only the subharmonic order. The harmonic order is an expression of frequency multiplication; the subharmonic order is an expression of frequency division.

However, this theory of musical structure does not depend upon acoustical phenomena. Its basis is in numerical orders which human beings readily apprehend and relate and which certainly extend both ways from unity. It is essential to recognize that fractional as well as whole-number functions relate to the number 1, and that human beings are capable of their recognition and association. The major triad is an expression of the integral functions 1, 3, and 5; the minor triad is certainly an expression of the reciprocal functions 1/1, 1/3, and 1/5.

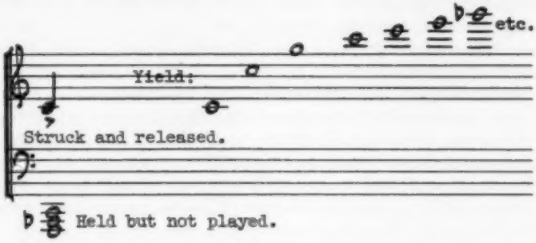
The historical rejection of the fractional functions as a basis for the minor mode is understandable if for no other reason than that these functions have been equated with the subharmonic series, which cannot be demonstrated acoustically with the same force as the harmonic set. It is reasoned, logically enough, that if acoustic phenomena are to be used to undergird a symmetrical theory of the two modes, a balanced acoustical demonstration is required. This preoccupation with acoustic phenomena and the difficulty of demonstrating the subharmonic series as an acoustical reality have been major stumbling blocks in the way of a symmetrical theory.

A second difficulty besetting the theory of the fractional derivation of the minor triad is the fact that the "root" or tone of derivation sounds as if it is the lowest of the three tones and not the topmost. To understand why this is so we must recognize that, acoustically speak-

ing, the reciprocal relationships are the functions of resonance and not of the vibrating element; as such they are only potential, not inevitable, concomitants of some physical act.

The word "resonance" is widely misunderstood. It is most often applied either to sympathetic vibration, which results when a mass is tuned to the frequency of an oscillating element, or to forced vibration, which occurs when a mass incapable of being tuned, (e.g. a piano sounding board) is energized by an oscillating element. Strictly speaking, resonance occurs when a mass is tuned to the frequency of a vibrating element or some submultiple of it. Thus, sympathetic vibration is one case of resonance; however, masses tuned to 1/2, 1/3, 1/4, etc. of the oscillator's frequency provide conditions of resonance and will respond with the frequency of the vibrating element. One can demonstrate this at the piano as shown in Ex. 1.

Example 1.



In this demonstration the C, A^{b}, and F strings which are left free to vibrate represent resonators at 1/4, 1/5, and 1/6 of the frequency of middle C. These strings will respond, not with their own frequencies, but with those of the exciting oscillator, middle C, and its harmonics. The potential character of the reciprocal functions is thus demonstrated by this fact: reciprocal relationships resonate only when a vibrating element sounding some multiple of their frequencies is brought into their presence, and such reciprocal relationships sound only the frequencies of that energizer and its harmonics.

When we play a minor triad, however, the potential nature of the reciprocal relationships is abandoned and the triad assumes some of the characteristics of its major counterpart; for when the minor triad is directly energized, it sounds its own set of frequencies and releases its own set of harmonics, which tend to affirm the triad's bottom tone as its tone of derivation or an apparent root. In this paper all minor triads will be designated by the tone which represents the numerical unity to which the other tones of each triad relate as divisions by the functions 3 and 5. Thus, traditional C minor will be called G minor, traditional A minor will be called E minor, etc.

Centuries of theoretical confusion have resulted from the acoustical illusion just described. Failure to differentiate between the order of reciprocal functions derived from a unity above and the character of the acoustical representation which tends to indicate a derivation from a unity below has had enormous effect upon musical theory. Though it

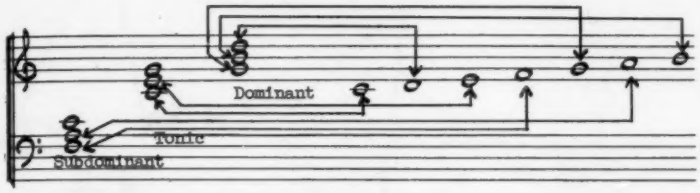
is difficult to reject the superficial information provided by our senses in favor of contrary information obtained through closer examination and more precise reasoning, it is often essential for the development of an art or a science. For example, the evidence of our eyes would support the notion that the sun revolves around the earth, but what would be the state of our knowledge of the cosmos if this idea had prevailed?

It is also necessary for us to recognize certain attitudes which have sprung from our notational system. The notions that sharps rise, and flats fall, that diminished intervals contract while augmented ones expand, that augmented fifths are dissonant but minor sixths are consonant lead us into semantic and notational postures which sometimes border on the comic. Examples of this kind abound in every harmonic and analytical treatise and need not be enumerated here. However, we must recognize that much of our terminology and our theoretical thinking is informed by the eye and has no connection with the indigenous relationships which exist between tones. In a sense, the whole concept of chromaticism is based on the fallacy that a tone is not materially changed when we apply an accidental since we write it in the same place and apply the same letter designation. Conversely, a G♯ is very different from an $A^{\flat}$ since we write it in a different place and apply a different letter designation. The confusion is compounded by definitions of tonal and chordal "tendencies" which are naive and misleading. Some relief from the chaos of these traditional modes of thought may be found by applying functional designations in the manner to be described briefly now.

Figure 1 (p. 158) and Fig. 2 (p. 159) show a geometric disposition of our tonal materials at the 1, 3, 5, and 1/1, 1/3, 1/5 functions, respectively. Tones in any single triangle are related at the 5 (or 1/5) function while those in adjacent triangles are related at the 3 (or 1/3) function. This process may be continued endlessly. Comparison of the two figures will disclose that the tones and relationships are precisely the same. The difference between them lies in the fact that in Fig. 1 the tones are generated by multiplication from a $G^{\flat}$ 1, whereas in Fig. 2 the tones result from a division of an E♯ 1/1. An interval obviously does not care whether it is considered from the top or the bottom, but since it is easier for most of us to think in terms of integral numbers we shall draw our examples from Fig. 1 rather than from Fig. 2. However, it should be borne in mind that both illustrations are relevant to the theoretical considerations which follow.

Examination of the major triads of C major reveals a C 45 whose third, E, is 45 X 5 or 225, and whose fifth, G, is 45 X 3 or 135. By making similar multiplications of G 135 we find a B 675 and D 405. From F 15 (1/3 of C 45) we discover an A 75 and, of course, C 45. Since these triads, C-E-G, G-B-D, and F-A-C, yield the tones of the major scale and a primitive and balanced harmonic system, I define their association as a tonality (Ex. 2). A major tonality is composed, then, of three major triads, nothing more, whose roots are disposed as function 1 (tonic), function 3 (dominant), and function 1/3 (subdominant). The 3 and 5 functions are applied to the roots C, G, and F to

obtain the complete triad of each.

Example 2. The C Major Tonality

This is a tighter concept of tonality than that usually proposed, since it excludes all structures other than the three mentioned and permits no "alteration" of these. Obviously, shifts from one tonality to another are frequent in any triadic composition. To support this idea of tonality and describe the movement from one tonal center to another we must define certain primitive relationships which exist between tonalities. The most common relationship involves a movement of the tonal center to the 3 or 1/3 position — to G or to F from C. Nothing concerning this relationship need be said here since it is commonplace and widely accepted. An association somewhat less well understood, however, is that existing between relative tonalities. The relative minor of C is traditionally called A minor, but since we have shown the tone of derivation of minor elements to be the traditional triadic fifth, we shall call that relative minor E minor and spell its tonic chord E-C-A. Referring again to Fig. 1 we find E 225 and C 45 in the triangular complex headed by C, and A 75 as a member of the F complex. To obtain the subdominant in minor we apply the 3 function because it is the numerical counterpart of the 1/3 subdominant relationship in major. Similarly, to obtain the dominant in minor we apply the 1/3 function to balance with the 3 function which we applied to produce the dominant root in major. The subdominant of this E minor tonality then is B-G-E (the 3 function of E) and we find B 675 and G 135 in the G complex, while E 225 is found in the C complex as before. The dominant A-F-D (the 1/3 function of E) is derived from an A 75 in the F complex along with F 15, while D 25 is found to be a member of the $B^{\flat}$ complex. An examination of these triads shows the roots disposed as 1/1, 3 and 1/3 (E, B, and A, respectively) while the relations of root, fifth and third in any triad are disposed as 1/1, 1/3, 1/5, respectively. These three triads comprise the E minor tonality, and the scale to be derived from their tonal complement descends from E. In terms of successive intervals this scale is the mirror image of the major scale (Ex. 3).

Example 3. The E Minor Tonality

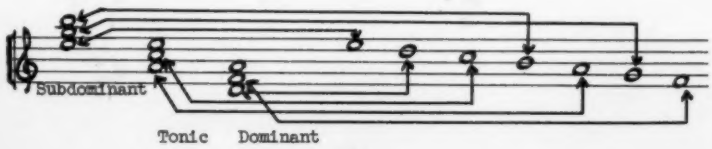


Figure 1.

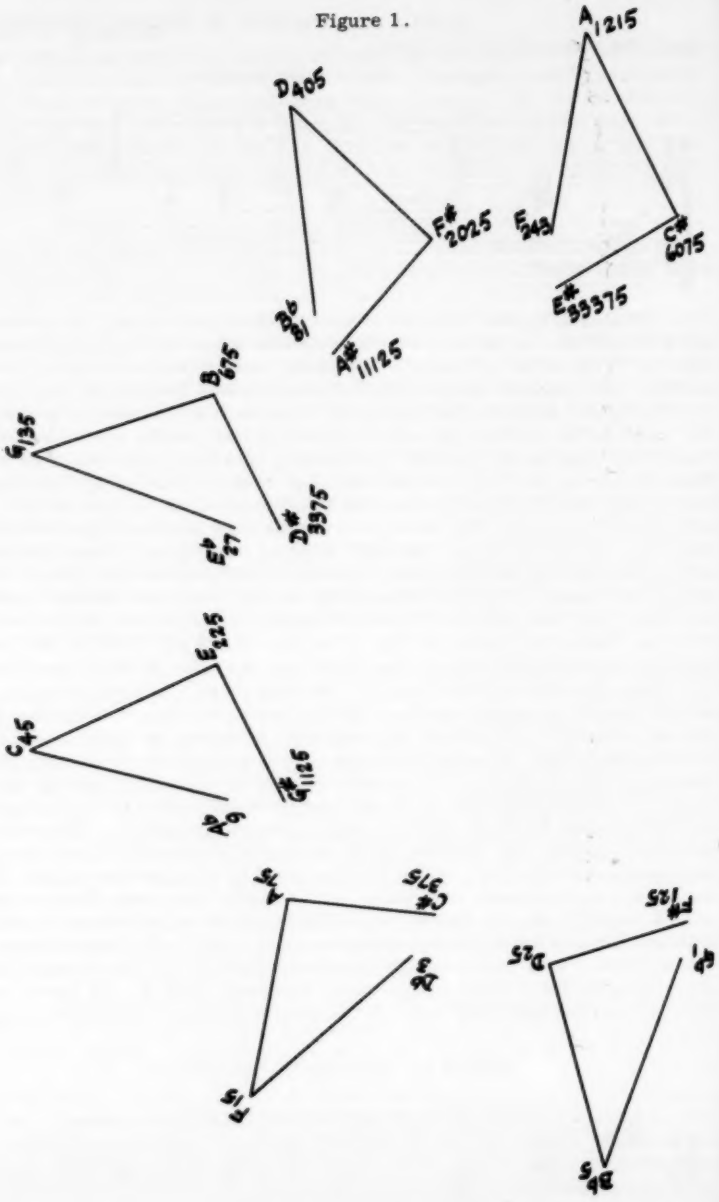
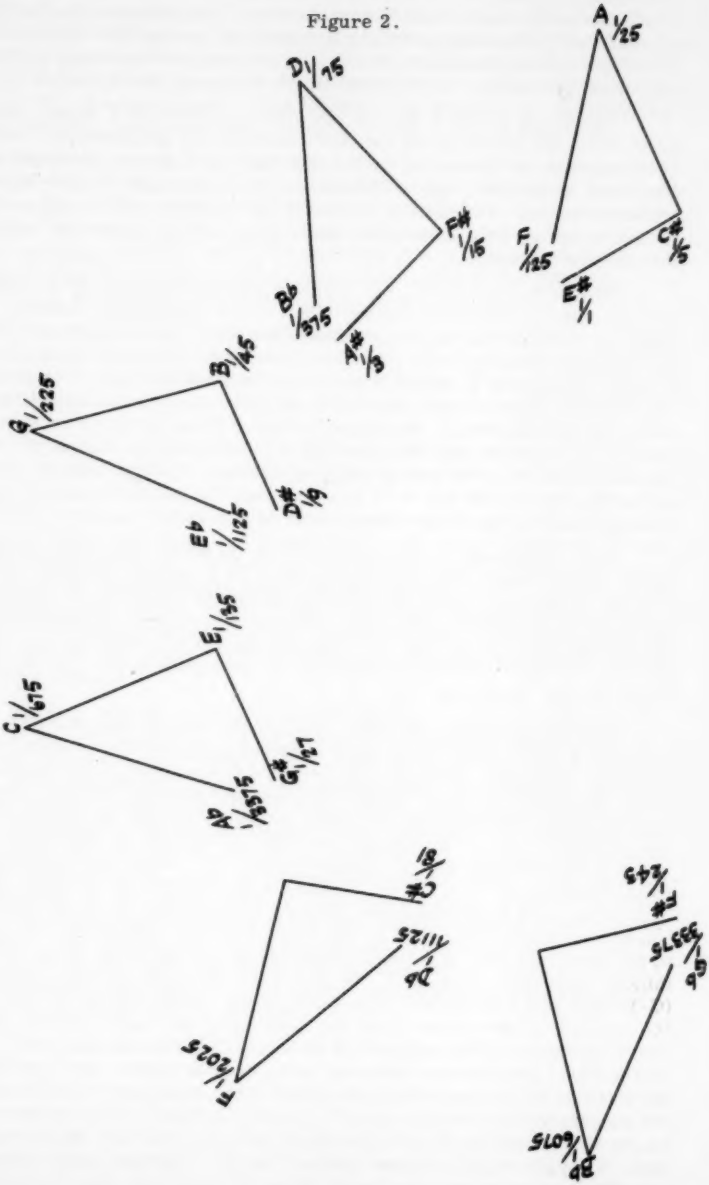

D405
F# 2025
B♭ 81
A# 11125
A 1215
F 242
C# 6075
E# 99375
B♭ 675
G 135
E♭ 27
D# 3375
E 225
C 45
A♭ 9
G# 1126
A 75
C# 375
B♭ 3
F 75
F# 125
D 25
E♭ 1
B♭ 5

Figure 2.


D 1/75
F# 1/15
Bb 1/375
A# 1/3
A 1/25
F 1/125
C# 1/5
E# 1/1
B 1/45
G 1/225
D# 1/9
E 1/125
A# 1/375
E 1/135
C 1/675
G# 1/27
A# 1/375
C# 1/81
Db 1/1125
T 1/2025
Eb 1/3375
F# 1/243
B 1/6075

It will be noted that the subdominant root (B) is actually the fourth degree of the minor scale, and the dominant (A) is the fifth degree. The 7th of the minor dominant 7th is, like its major counterpart, the 4th degree of the scale. In this tonality the dominant 7th is A-F-D-B.

The tones of the C major tonality and those of E minor are the same, with the exception of the D 405 found in the dominant of C and the D 25 found in the dominant of E. Multiplying D 25 by successive 2's (octaves) so that we may compare the two tones (25-50-100-200-400) reveals that their difference is that of the comma: 405 to 400 or 81 to 80. This is the first instance of tonal difference to be discovered from this method of tuning.

The tonic, dominant, and subdominant triads of E minor are, of course, the VI, II, and III respectively of the traditional concept of C major. Yet there is no acceptable reason why minor structures should be included in a major mode. The traditional concept comes from a predicated scale with triads built on each successive tone. In the theory presented here, however, the scale results from triadic units disposed in the closest possible numerical order. Thus, it appears to be important to separate the relative minor tonality from the major and to do away with the practice of applying Roman numeral designations to scale degrees as triadic roots. In this way the major tonality becomes entirely major, the minor tonality entirely minor.

The traditional I, IV, and V triads coincide with our concept of tonic, subdominant, and dominant triads of a major tonality; the traditional II, III, and VI triads have been shown to form the relative minor tonality. This leaves only the "leading-tone triad" unaccounted for among the diatonic triads of a traditional major tonality. An understanding of this structure involves an examination of the structure known as the "dominant 7th."

It is well known that the "7th" of the major dominant 7th (F of G-B-D-F) is not a true numerical 7 function. In traditional terminology the word "seventh" refers to the line and space count between the root G and the "7th" F. Such terminology neither defines the F in terms of its numerical function nor accounts for its universal acceptance as a "chord tone." The F we employ as "7th" of the major dominant is the same F we obtained as the function 1/3 of C. Since G is related to C as the function 3, F is 1/9 of G; since B is the function 15 when related to C, F is 1/45 of B; and since D is the function 9 of C, F is 1/27 of D. These relations offer little by themselves to help us define the nature of the dominant 7th. An examination of the dominant 7th of the relative minor, however, reveals F, D, and B as common to both sonorities (G-B-D-F and A-F-D-B). The third of the major chord, B, becomes the seventh of the minor, and the seventh of the major chord, F, becomes the third of the minor. It would appear that the inclusion of the tone we call the 7th in a dominant structure is really the inclusion of the third of the relative dominant triad which combines with the fifth of the structure (D in our example) to produce a chord which sounds like a single entity capable of participating in either of the two relative tonalities. Though we have shown earlier that the D of the major dominant and the D of the minor dominant differ by a comma, the difference is

lost in equal temperament, and the two structures remain undifferentiated in this respect as do their thirds and sevenths. Cadences from the major dominant-7th to the relative minor tonic (the so-called deceptive cadence) and cadences from the relative minor dominant-7th (A-F-D-B), the traditional "leading-tone 7th-chord") to the relative major tonic are understandably common in our musical literature.

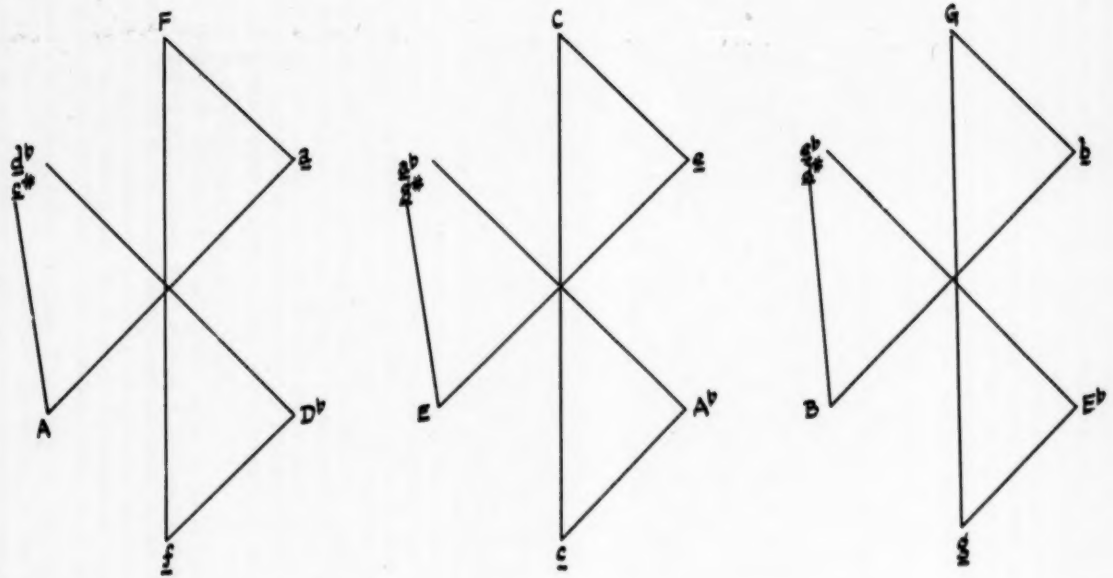
The so-called leading-tone triad emerges as either the third and fifth of a major dominant (B 675 and D 405) compounded with the third of the relative minor dominant (F 15); or the third and fifth of a minor dominant (F 15 and D 25) compounded with the third of the relative major dominant (B 675). Either way, without a precise articulation of D 405 or D 25 it is impossible to determine which of the two tonalities is the more fully represented in the structure.

A third association of tonal centers may be observed in what we might call the "reflected" minor (or major). In this instance the roots of the three triads in minor are the same as those in the major. Thus, from C major a C minor tonality (C-A^b-F) emerges from the reciprocal functions of C, G, and F. Referring again to Fig. 1 (p. 158), we see that A^b 9 is the 1/5 function of C 45, and that F 15 is the 1/3 function of C 45; similarly E^b 27 is 1/5 of G 135, and C 45 is 1/3 of G 135; by the same token, D^b 3 is 1/5 of F 15, and B^b 5 is 1/3 of F 15. The relationship between C major and this tonality of C minor is extremely important since the tonal complement of one is often employed in conjunction with the other. In Exx. 4 and 5 (p. 163) some progressions involving shifts between these tonalities are shown. It will be noted that the progressions shown in Ex. 4 are the mirror images of those shown in Ex. 5. The SATB voices in Ex. 4 are inverted to become the BTAS voices in Ex. 5. The intervals remain precisely the same but the tonalities reverse.

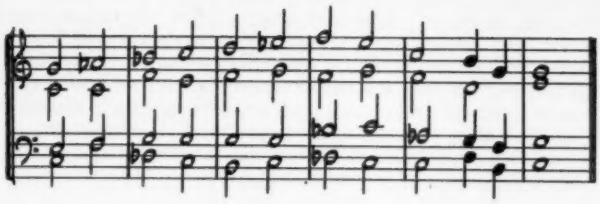
To sum up, the primitive relationships between tonalities are found to be based on a 1-3-5 pattern. The reflected relationship is a function of 1 since the triads of each tonality share the same roots in an integral-reciprocal manner; the association of dominant and subdominant keys indicates the function of 3 and 1/3 respectively; the relative minor relationships are those of the function 5 since the minor triads are the reciprocal functions of the thirds of each of the major roots. In passing we must point out that the A^b major tonality is the 1/5 function of C and as such is also the relative major of C minor (C-A^b-F). Relations between tonalities expand infinitely, of course, with the 1-3-5 functions as their foundation. As these relationships become more distant the tonal functions become more complex. In equal temperament, unfortunately, functional differences are lost in enharmonic notation and tone production.

The most important conclusion to be drawn from this view of related tonalities is that as we move from one tonality to another or simultaneously associate one tonality with another we apply the same 1-3-5 functions as those which relate one tone to another in a triad and one triad to another in a tonality. In Fig. 3 (p. 162) is shown an organization of tonalities on the 1-3-5 basis to which we might apply the name "triality." Each letter in this figure represents a tonality

Figure 3.



Example 4.



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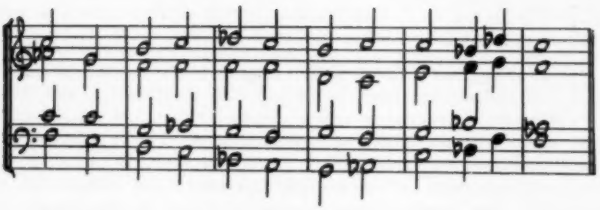
Example 5.

ct CT CD_7 ct cd_7 CS CD ct CT cd cd_7 c

Figure 3.

consisting of three triads. Starting then from the tonality of C major we can observe its relation in varying degrees of complexity with 17 other tonalities. The triality represents a new dimension in tonal organization.

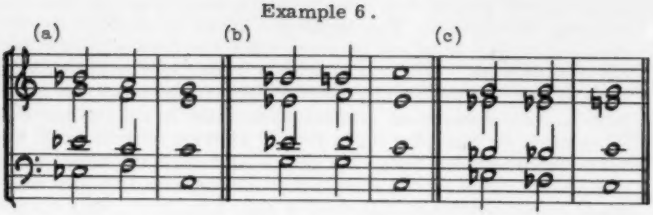
Such a view makes a shambles of the doctrine of chromaticism. In the traditional analysis of harmonic structure the practice of identifying certain tones as "altered" stems from the failure to define tonality in precise numerical terms and to relate one tonality to another in similarly precise numerical terms. The so-called Neapolitan and German-6th chords, for example, are clearly members of the A^{b}-major tonality which has a specific numerical relationship to that of C major. It is difficult to see why the E^{b}-major structure has been disregarded by most theoreticians, for it can produce telling cadences with chords of the C-major tonality (Ex. 6, p. 165). In any event, it is neither necessary nor accurate to identify as "altered" any one of a confluence of tones derived from a triadic base.

Many of our structures are clearly the result of the simultaneous sounding of chordal elements. Such chords as the "supertonic 7th," "mediant 7th," "subdominant 7th," "dominant 9th," etc., are formed from relative major and minor tonalities (Ex. 7, p. 165). The association of reflected tonalities produces such chords as the augmented 6th, which is an exceptionally interesting example illustrated in Ex. 8a (p. 165). In this instance the structure is composed of the dominant 7th of C minor without its fifth (F-D^{b}-G) and the dominant 7th of C major without its fifth (G-B-F). The structure resolves to either tonic with equal ease (Ex. 8b, p. 165). By rewriting the chord to avoid minor 9ths, which often (but not always) sound like the extremely complex prime number 17, we are able to include the two fifths, B^{b} and D, thus greatly increasing the pungency of the sound. Resolution of this compound chord to the C major and C minor tonics simultaneously is entirely plausible to the ear. Additional chords produced by the association of reflected tonalities appear in Ex. 9 (p. 165).

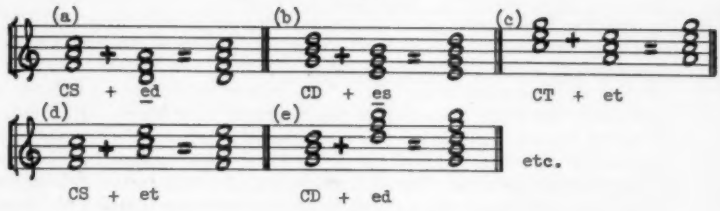
A progressively complex order of such compounds may be logically expected from what is historically established practice. That is, by giving heed to what is now commonplace in chordal construction, we may deduce that further compounding of triadic elements is not only possible but highly desirable. Unfortunately the old wine-skin of equal temperament will no longer hold the new tonal wine. As complexities increase, the approximate pitches of equal temperament become less and less functional and their intervals produce more and more meaningless beating and noise.

The solution to this difficulty is an instrument with many more than 12 tones per octave all related on the numerical basis of 1-3-5 and 1/1-1/3-1/5. Mechanical vibrators and unsynchronized electronic oscillators cannot be made to hold their pitch for more than a few seconds and therefore are useless in this situation where frequency is so critical. Their use involves the further disadvantage of chain tuning, each tone being tuned to another in sequence. Any slight error early in the

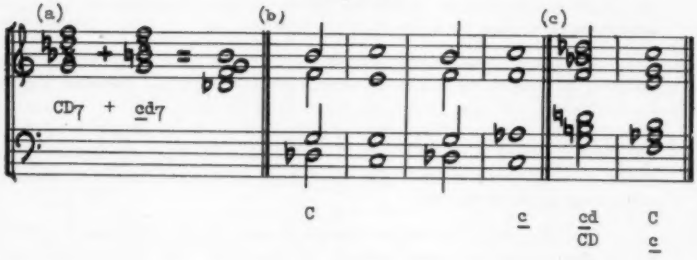
Example 6.



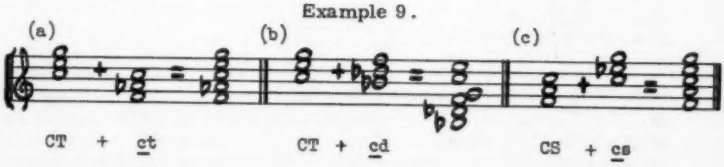
Example 7.



Example 8.



Example 9.



chain throws off the entire tuning and necessitates the laborious task of retuning throughout. The technique known as electronic synchronization employing standard vacuum tubes as frequency dividers solves these problems. The Synchronized Tone Generator to be described here is a small model of a much larger instrument now nearing completion. An instrument similar to this one has been in service in my laboratory for the past three years, where I have found it to be an invaluable device for the investigation of numerical pitch-orders. It is completely reliable and simple and inexpensive to build. A block diagram of the instrument appears in Fig. 4 (p. 167). This diagram shows that oscillations at 24,000 cps are passed to a one tube amplifier. From there they go to three primary dividers which divide that frequency exactly by 4, 6, and 9, yielding tones of 6,000, 4,000, and 2,666 cps, respectively. The functions represented by these divisions are 1/1, 1/3, and 1/9. (Division by 4 yields a tone two octaves below 1; division by 6 yields a tone one octave below a division by 3). Considering the 24,000 cycle tone as an F#, which it approximates, the tones produced by the three primary dividers are F#, B, and E. Each of these frequencies is now given to a pair of secondary dividers, which are under the direct control of the operator and which will produce 25 or more further divisions. The tone of derivation to which each of the secondary dividers is referred is the tone of the primary divider which is impressed upon it. Thus six streams of tones in the sub-harmonic order are available from three primary sources which are precisely ordered on the basis of the perfect fifth. The numbers listed on the left in each of the secondary divider blocks in Fig. 4 refer to the actual division being made by the tube and its associated components; those on the right in each block refer to the reciprocal function of the number 1, which in this case is a pitch of 24,000 cycles.

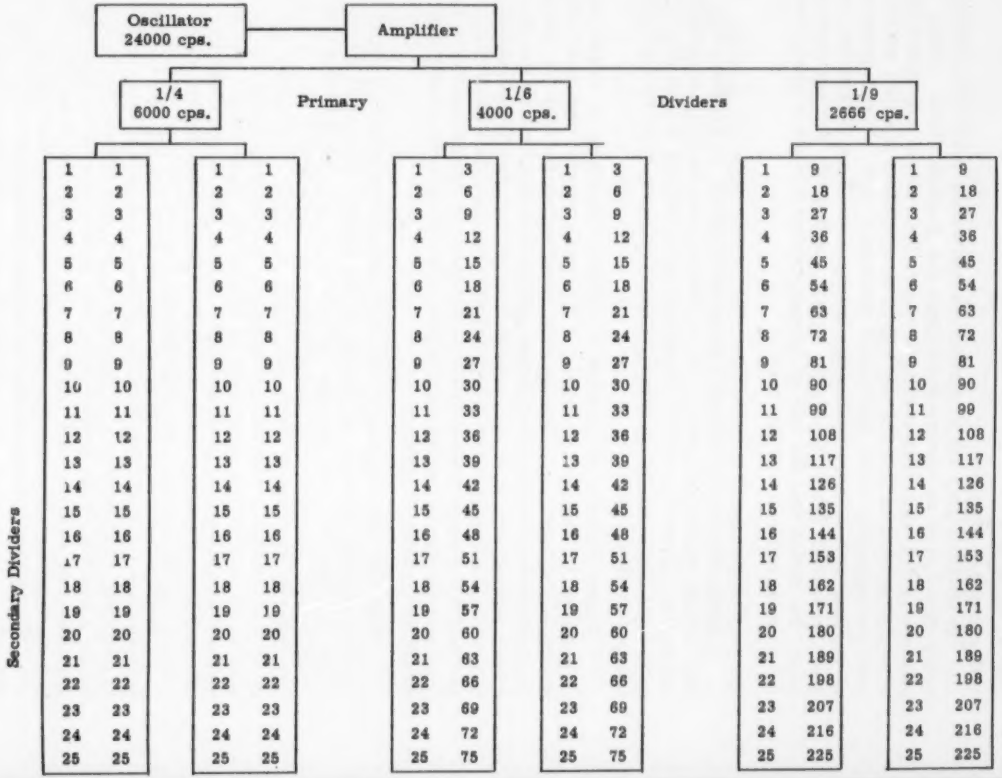
Figure 4.

To set a divider for a particular function the operator counts the number of divisions while he advances the control. Beyond the division by 8 the ear is less and less able to distinguish the relation between successive tones. However, since divisions by 4, 5, and 6 of each divider produce a minor triad, reference to this series of tones provides the operator with a quick and convenient method of orientation for any count beyond the 8th.

To demonstrate major triads some simple arithmetic is required since the operator must select tones from the reciprocal series to form the integral functions 1-3-5. For example 1/15-1/5-1/3 have such a relationship. From our F# 1/1 we note that 1/15 is G, 1/5 is D, and 1/3 is B. Similarly 1/45-1/15-1/9 form C-G-E, 1/75-1/25-1/15 form E^b-B^b-G, and so forth.

The major dominant-7th sound involving a true, numerically correct 7th is more difficult to obtain since its root is 1 over the product of 1 X 3 X 5 X 7 or 1/105. The function 1/105 of F# is roughly A, 1/21 is C#, 1/35 is E, and 1/15 is G. These reciprocal functions relate as the integrals 1-5-3-7, respectively. The 105th division can best be obtained by using a primary division of 5 or 7. From a primary division of 5, the 105th division is obtained from the 21st secondary division; from a primary division of 7, the 105th division is available from the

Figure 4.


Oscillator
24000 cps.
Amplifier
1/4
6000 cps.
Primary
1/6
4000 cps.
Dividers
1/9
2666 cps.
Secondary Dividers

IAN A. MORTON

15th secondary division.

In order to play major structures containing primes of a higher order than 7 it is necessary to continue the multiplication. Thus, to obtain a pure major dominant-11th sound, the root is expressed as 1 over the product of 1 X 3 X 5 X 7 X 11 or 1/1155, a division well beyond the capability of the instrument described here. The experience of working with a more elaborate Synchronized Tone Generator, one which produced functions of this order, confirmed, for my ears at least, the notion that the use of primes beyond 5 is not a likely field for musical expansion at this time.

Since practice is supposed to precede theory in musical life, it may not be considered proper for a theoretician to offer speculative proposals. However, certain observations pertaining to this theory of numerical functions and to experimentation with the Synchronized Tone Generator should be made.

First, it should be possible to advance considerably in the field of analysis by employing numerical functions rather than traditional chromatic terminology. Every tone of composition may be plotted graphically with numerical function as one axis and time as the other. Such a method should reveal unsuspected points of unity or centers of tonality since detailed analysis inevitably uncovers the sweep of larger patterns by visible emphasis in some area of the numerical order. This method should end the ambiguity of traditional terminology and the falsity of traditional analysis.

Secondly, the teaching of harmony may be immensely simplified. The minor mode as a mirror image of the major, the end of all chromatic "alteration," the precise definition of all "neighboring tones," "auxiliaries," "suspensions," "appoggiaturas," "free tones," etc. in terms of numerical function — these may make the study of harmony an orderly and constantly expanding discipline. It should be possible for the student to move from simplicity to complexity in a logical and predictable fashion and to leave his study with a very comprehensive view of musical construction of the past and of possibilities for the future.

In conclusion it may be of interest to point out that what pertains to frequency relationships in terms of the 1-3-5 orders also pertains to temporal relationships. For example, we may define the half-note as the 2 function of the quarter-note, or, in simpler terms, its octave. Similarly, the quarter-note triplet is the 1/3 function of the half-note, and the eighth-note quintuplet is the 1/5 function of the quarter-note, etc. Electronic techniques may be employed here, as well as in the field of tone production, to yield ordered and synchronized pulses which in turn may be used to key tones in various time patterns from a 1-3-5 base. An instrument to do this is now under construction in conjunction with an advanced Synchronized Tone Generator. A still more elegant device is contemplated which will operate from a musical syllogistic involving feedback loops to determine relationships yet to come from those already sounded, thus motivating subsequent music by music already past. Such a syllogistic is a logical step from the concept of numerical orders in music as it has been presented here.

THE HARMONIC THEORIES OF KIRNBERGER AND MARPURG

by

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During the years 1722-1760, Jean-Philippe Rameau published the series of treatises in which he developed his theory of harmony, a theory that changed the musico-theoretical thinking of his own time and greatly affected that of future generations. Certain of his contemporaries were quick to recognize the value of his ideas; others rebelled against what they considered to be abstract theorizing far removed from actual musical problems. Friedrich Wilhelm Marpurg (1718-1795) belonged to the first category. He regarded himself as the first disciple of Rameau in Germany, the official disseminator and interpreter of his theories. This was most unfortunate for Rameau, for Marpurg did not understand the full significance of Rameau's theories and, as we shall see, questioned statements without having fully understood their context. For example, he missed entirely one of Rameau's most basic views: that melody, even unaccompanied melody, has its roots in harmony. Indeed, he even states a contrary view: "Aus Tönen entstehen Intervalle, und aus Intervallen Accorde [Handbuch bei dem Generalbasse, Vol. 1, 2nd ed., p. 4]." And the basis of Marpurg's method for deriving a scale is the erroneous experimental observation of a subharmonic series reported by Rameau in his Génération Harmonique (1737) and later corrected in Démonstration du principe de l'harmonie (1750). Marpurg seems never to have read the latter; at least, he did not correct his mistake.

In contrast to Marpurg, Johann Philipp Kirnberger (1721-1783) regarded himself as a practical theorist. He bitterly opposed theories which he regarded as being far removed from practical musical problems. Some aspects of his work reflect the thought of the generation of his teacher, Johann Sebastian Bach, but the most significant aspects of his work face the future and are reflected in the writings of a later generation.[1]

Before making a closer comparison of the ideas of Kirnberger and Marpurg it may be helpful to survey their major writings.

Marpurg wrote prolifically on many subjects: counterpoint, harpsichord playing, ornamentation and performance practice, and music theory. His theoretical works are listed below.

Des critischen Musicus an der Spree, 1750 [Musicus]. A periodical containing a series of articles which outline a theory of harmony.

1. In, for example, the writings of Türk, Kollmann, Gottfried Weber, Richter, and others.

This was developed more fully in the Handbuch bei dem Generalbasse listed below.

Abhandlung von der Fuge..., 1753-54.
A detailed treatise on the fugue.

Handbuch bei dem Generalbasse . . ., 1755-1760 [Handbuch].
A large and comprehensive textbook on harmony, composition, and theory of harmony.

Herrn d'Alemberts... Systematische Einleitung in die musikalische Setzkunst nach den Lehrsätzen des Herrn Rameau, 1757.
According to Shirlaw [5, 308] this is primarily a translation of d'Alembert's Élémens de Musique (1752).

Anfangsgründe der theoretischen Musik, 1757.
This is principally a treatise on tempered tunings.

Kritische-Briefe über die Tonkunst, 1760-64.
A large collection of essays on almost every aspect of music. Of particular interest is a letter to C. P. E. Bach (p. 25) in which Marpurg defends his harmonic theories.

Historisch-Kritische Beyträge zur Aufnahme der Musik, 1760.
A collection of essays on music in five volumes. The long article entitled "Untersuchung der Sorgischen Lehre von der Entstehung der dissonirenden Sätze" in Vol. 5 [Untersuchung], contains the core of Marpurg's harmonic theory.

Herrn Sorgen's Anleitung zum Generalbasse mit Anmerckungen von F. W. Marpurg, 1760 [Anleitung].
It is in this work that Marpurg repeats Rameau's misconception of the nature of the partial series, an erroneous thesis upon which he bases his own construction of a chromatic scale.

Versuch über die musikalische Temperatur nebst einem Anhang über den Rameau- und Kirnbergerschen Grundbasse, 1776 [Anhang].
The Anhang of this work and the Untersuchung provide the essential material of Marpurg's harmonic theory. The Anhang is made up of extensive quotes from Kirnberger's Die wahren Grundsätze zum Gebrauch der Harmonie together with critical remarks on the quoted passages.

Unlike Rameau, Marpurg did not develop and change his theories in successive publications. His first theoretical writings in the Musicus are only preliminary sketches for a theory. The Handbuch is the first and most comprehensive statement of the completed theory. Except for minor alterations, and the fuller explanation of his views on dissonant combinations given in the Anhang and the Untersuchung, his ideas remain essentially the same. Marpurg is a man quick to point out and to attack those whom he considers to have strayed from Rameau's straight and narrow path. And in his polemical writings, in the Anhang and the Untersuchung, for example, he is sometimes given to excessively arbitrary general statements and abusive language. However, his respect for Kirnberger was genuine [Anhang, 233], and although he disagreed with him violently he spared him from the more

picturesque figures of speech with which he attacked Sorge.

The theories of Kirnberger are contained in two works: Die Kunst des reinen Satzes, 2 vols., 1771-79 [Kunst]; and Die wahren Grundsätze zum Gebrauch der Harmonie, 1773 [Harmonie]. The first is the definitive work; the latter is shorter, giving more attention to the fundamental bass and problems of musical analysis. Its relationship to the Kunst as well as to Kirnberger's student, J.A.P. Schulz, are explained by Siegfried Borris [2, 97-8]. A second and even more condensed treatment of harmony is his Grundsätze des Generalbasses, 1781 [Grundsätze].

Kirnberger is a more lucid and reasonable writer than Marpurg. However, when his common-sense aural approach to theoretical problems, which is basically sound, is displaced by purely intellectual speculation, the results are sometimes unfortunate. Yet, in matters of practical theory and harmonic analysis, he seems to be a man of greater musical insight than Marpurg. In the remainder of this paper the theories of each of these men will be taken up separately, beginning with those of Marpurg. Primary attention will be given to their views on basic chord material, its derivation, and dissonant combinations such as the 9th, 11th and 13th chords. We will then use the Anhang as the basis for a comparison of their views on the fundamental bass and certain problems of harmonic analysis involving the question of essential and "accidental" (non-essential) discords.

Throughout his writings Marpurg seems to be unaware of the evident inconsistency between his avowal of French apostleship and his openly dissenting opinions. We have quoted him as saying, "Aus Tönen entstehen Intervalle, und aus Intervallen Accorde." The extent to which this statement is at odds with the theories of Rameau becomes apparent when one understands that by "Tönen" Marpurg means scales. This meaning is clear not only from the discussion that follows the statement [Handbuch, 4-5] but also from the order in which various musical materials are considered. First he discusses the means by which scales (diatonic and chromatic) are derived. He then obtains his chord material from this melodic material. Rameau, however, first derives intervals from the senario, then major and minor harmony, and only after that does he construct scales.

Marpurg considered Rameau's system to be incomplete [Untersuchung, 136] and offered instead a "combined Rameau-Marpurg system." In order to be complete, he maintained, a system must contain all possible tones, intervals, and chords, insofar as they are possible practically. This requires twenty-one pitches in an octave — although Marpurg does not give a table of them; and from a two, three, or four-fold combination of these, all possible intervals and chords may be derived [Untersuchung, 136]. The basis for his method of scale construction is an error of observation made by Rameau in his Génération Harmonique (1737). In a series of expériences Rameau seems to discover not only the origins of major harmony in the senario of a vibrating string, but also the origins of minor harmony in the co-vibration of strings whose

lengths are multiples of the agitating string. Marpurg restates this observation both in the Anleitung (p. 5) and in the Untersuchung (p. 145), but without any of Rameau's mathematical "proofs." Except for his treatises on tuning, Marpurg's theoretical works deal primarily with practical observations and speculations and only summarily with acoustical and mathematical proofs. With major harmony (C-E-G) provided by the "erklingende" tones (the upper-partials) and minor harmony (F-A^{b}-C) by the "erzitternde" tones (the fictitious lower-partials, or "sub-partials") he proceeds to construct a scale, using only the "erklingende" and "erzitternde" fifths provided by Rameau's erroneous observation. Beginning with the Grundnoten C, E, and G, Marpurg obtains the notes G, B, and D from the erklingende fifths C-G, E-B, and G-D. Next, he obtains the notes F, A, and C from the erzitternde fifths C-F, C-A, and G-C. D, $F^{\sharp}$, and A then are obtained as erklingende fifths from G, B, and D, while B^{b}, D, and F arise as erzitternde fifths from F, A, and C. By the above method of pitch-derivation, Marpurg obtains all the necessary tones, intervals, and chords from three basic triads: C-E-G, G-B-D, and F-A-C. However, he says that we need only the kinds of intervals found within the range of a primary key and its five nearly related keys, and which "in relation to C major and A minor [representing a major key and its relative minor] arise from the various combinations of the twelve half-tones, C, $C^{\sharp}$, etc." [Untersuchung, 146]. The proportions of the intervals are obtained by, first, comparing the upper partials, C, c, g, c', e', g', and c" with the resonating body C. This yields the following ratios:

1:2 = C:c - the octave

1:3 = C:g - the twofold fifth (die zweyfache Quinte)

1:4 = C:c' - the twofold octave

1:5 = C:e' - the threefold major third

1:6 = C:g' - the threefold fifth

1:8 = C:c - the threefold octave

From these the following set of ratios is derived:

1:2 - octave

2:3 - fifth

3:4 - fourth

4:5 - major third

5:6 - minor third

5:8 - minor sixth

3:5 - major sixth [Untersuchung, 146-7]

Having thus obtained the ratios for all intervals, with the exception of the different species of seconds and sevenths, Marpurg now proceeds to "higher" mathematics. From the previous ratios he obtains the proportion 1:2:3:4:5:6:8, and by various mathematical operations he obtains all the missing ratios. The square of the fifth 2:3 yields the major

ninth 4:9 = C:d. This may be reduced to a major whole-tone by raising the lower partial an octave, viz. 8:9 = c:d [Untersuchung, 148]. Its inversion, 9:16, yields the minor seventh D:c. The addition of a fifth and a minor third produces the ratio 5:9 for the minor seventh E:d; and its inversion 9:10 produces the minor whole-tone d:e. From the addition of a fifth and a major third comes the ratio 8:15 for the major seventh. Its inversion 15:16 gives the major half-tone. Finally, from the square of the major third 4:5 comes the augmented fifth 16:25. When the ratio of the fifth 2:3 is taken from this, the minor half-tone 24:25 remains [Untersuchung, 149]. Marpurg has now accounted for every interval which he considers essential to his system.

The foregoing has shown that Marpurg comprehended and accepted Rameau's theory of inversion. Since his discussion of sixth chords and six-four chords adds nothing new it will not be dealt with here. Marpurg also accepts Rameau's idea that the basis of chord construction is the manipulation of thirds. However, in giving his reasons for using thirds and in his description of their use and function he wanders far from French territory. Rameau justified his use of thirds by his observation that all chords in fundamental position are formed in a series of thirds. Marpurg also makes this observation, but proceeds to justify it further by listing all intervals according to frequency of occurrence in the complete system of twenty-one scales and twelve major and twelve minor keys. He is distressed by the fact that the minor third occurs more often (18 times) than the major (17), but he dismisses this observation, remarking that this is not at all detrimental to what he deems the "natural superiority" of the major third [Untersuchung, 151], by which he means that in the senario 4:5, the major third, occurs before 5:6, the minor third. In discussing the construction of the major and minor triad, he says that both are composed of a third and a fifth from the fundamental, therefore composed of thirds. He observes the difference between the characteristic thirds but not the fact that each triad is made up of one major and one minor third.

The actual formation of 7th and 9th chords gives Marpurg no trouble. The 7th chord is formed by superimposing a third above the fifth, the highest tone thereupon forming a seventh with the bass, and the full chord remaining within the octave [Untersuchung, 162]. Marpurg follows Rameau's basic precept that even if the range of a complete chord exceeds the octave its roots must lie within that interval. Thus, the 7th chord is essential, its root a real root. To form a 9th chord a tone is added a third below the root of the 7th chord [Untersuchung, 169; Musicus, 171-2]. And to be consistent with his theory of chord formation, Marpurg finds the root of the 11th chord by adding two thirds, the root of the 13th chord by adding three thirds below the root of the 7th chord. However, he explains, these middle thirds are not practicable and are not in the Rameau-Marpurg system. Having eliminated these he leaves us with tones at the distance of a third, fifth, and seventh below the real root (the root of the fundamental 7th chord) as the "subposed" (untergeschobenen) roots of the 9th, 11th, and

13th chords, and thus completes his system of chordal formation.

With all chords thus accounted for, Marpurg then proceeds to speak of their nature and function. Both in these discussions and in his arguments with Sorge he reveals two weaknesses. First, he does not seem to grasp the real reason that notes are not added above the seventh to form 9th, 11th, and 13th chords; for, having only a dim comprehension of Rameau's basic premise that melody comes out of harmony, he does not fully understand that to add notes above rather than below would involve a discussion of suspensions, a discussion which undoubtedly would weaken this basic premise. That is, superposed notes might be explained as melodic events, as retardations of the essential chord notes. When, however, chords are constructed by "subposing" thirds the essential unity of the chord, the 7th chord, and the integrity of its root remain intact. Thus, if a 9th chord is constructed by superposing a third above the 7th chord, E-G♯-B-D, the ninth, F, may be regarded merely as a retardation of the essential note, E. However, if a 9th chord is constructed by "subposing" a third below E, the ninth remains a member of the essential chord, E-G♯-B-D. Even if it were regarded as a retardation it would resolve to C, a replica of the subposed root, which is not a member of the essential chord. Unfortunately, the last sentence of Sorge's one clear statement regarding the suspended, freely entering ninth spoils the whole, for it contains a vulnerable point which Marpurg is quick to attack, leaving unanswered the more important question of suspension [5, 315]. Secondly, he seems to be unaware of an important corollary to Rameau's principle of inversion. This principle, which is based on the assumption that octave tones are merely replicas of each other, states that the notes of any invertible chord must lie within the range of an octave. Therefore, the subposed roots cannot participate in inversions since their inclusion as real roots would extend the compass of the complete 9th, 11th, and 13th chords beyond an octave. Although Rameau makes this quite clear [Traité, 33], it seems to have escaped Marpurg, for in at least two instances he has included a subposed root in inversions. The first of these involves a 9th chord [Handbuch, 75], the second an 11th chord [Untersuchung, 174].

Although the greater part of Marpurg's theoretical writing is devoted to discussions and arguments on the subject of 9th, 11th, and 13th chords, (primarily on the necessity of subposed roots as a means of keeping the essential chord and the real root within the range of an octave) he shows no real insight into the nature of these chords. He employs fundamental bass progression to show that the real root is that of the 7th chord [Untersuchung, 179-81]. He does not do the same when discussing the inversions of these chords. These discussions serve to point up the difference between the view that 9th, 11th, and 13th chords are the result of melodic embellishment, as proposed by Sorge and Kirnberger, and Rameau's view that these chords are essential dissonances. While he remains the confused middleman, Marpurg inadvertently helps to clarify the arguments of each side for the 20th-century reader.

In order to maintain his position that the 7th chord and its root

are the essential elements in the construction of 9th, 11th, and 13th chords, Marpurg is forced to consider the diminished 7th chord as a fundamental chord [Untersuchung, 186; Musicus, 175; 181]. However, as his various descriptions of that chord reveal, Marpurg is by no means completely secure in his opinion. In the Untersuchung the diminished 7th appears as one of several types of 7th chord, and is described as the diminished 7th chord constructed from the minor diminished triad G#-B-D-F which is found only on the raised 7th degree in A minor [Untersuchung, 165]. In an earlier part of the Musicus he flatly states that the diminished 7th chord is not a fundamental chord. It is a "borrowed harmony" (eine erborgte Harmonie) on the raised leading-tone in minor derived from the inversion of the chord of the augmented second on the natural 6th degree in minor, F-G#-B-D [Musicus, 181]. Yet, further on, in his description of the construction of 9th, 11th, and 13th chords, we find these examples: 1) the 7th chord B-D-F-A^b as the essential chord of the 11th chord E/B-D-F-A^b;[2] 2) in minor, the fifth (E-B) of the chord is often changed to a minor sixth, in which case this 11th chord A/F-G#-B-D is derived from the augmented-2nd chord F/F-G#-B-D; 3) the chord with major third and diminished fifth E, G#, B, D, F, which does not differ from the foregoing chord except that the ninth is minor, the 7th chord B/B-D#-F-A, and the 11th chord derived from it E/B-D#-F-A [Musicus, 211]. These statements of course do not outweigh those of the Untersuchung which was written ten years later. There Marpurg maintains a sphinx-like silence when on such dangerous ground.

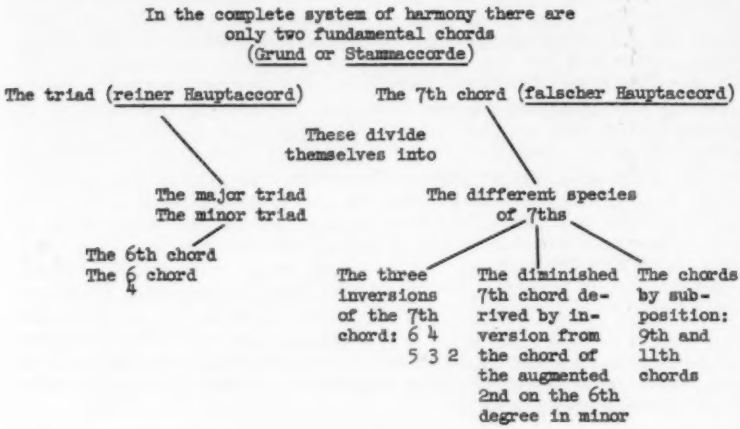
In the last examples from the Musicus (B/B-D#-F-A and E/B-D#-F-A) Marpurg has touched upon another thorny question, that of the augmented 6th chord. Although the examples of 9th chords given in the Musicus include such chords as the 9th chord derived from the augmented second on the 6th degree in minor (which is built by supposing a root, not at the interval of a third, but at the interval of a fourth below the "7th" chord F/F-G#-B-D), and the 9th chord G/B-D#-F-A derived from the "fantastic" 7th chord B/B-D#-F-A, there is no reference to anything resembling an augmented 6th chord [Musicus, 202]. Yet, ten years later Marpurg came perilously close to recognizing the augmented 6th chord when he stated that the chord F-A-B-D# came from the "fantastic" 7th chord B-D#-F-A. The augmented 6th chord F-A-C-D# comes, he says, from the 7th chord D#-F-A-C. Of the two, the former is the more frequently used, and both chords result from the mixing of two keys, A minor and E minor [Untersuchung, 167]. Although he describes these chords as belonging to a species of 7th chord which is used only in an inverted form, he does not say that they are fundamental chords, as are most of the 7th chords.

One of Marpurg's few concrete statements is his system of chord classification. We can follow the development of this from its first appearance in the Musicus, through its middle stages in the Handbuch, to

2. These are shorthand musical examples. The letter to the left of the slant represents the actual bass note.

its final form given in the Untersuchung. Since these three classification systems afford a neat summary of Marpurg's theories, as well as a chronological view of the development of the theories they are presented in full below.

I. From the Musicus (p. 220)


In the complete system of harmony there are only two fundamental chords (Grund or Stammaccorde)
The triad (reiner Hauptaccord)
The 7th chord (falscher Hauptaccord)
These divide themselves into
The major triad
The minor triad
The 6th chord
The 6/4 chord
The different species of 7ths
The three inversions of the 7th chord: 6 4 5 3 2
The diminished 7th chord derived by inversion from the chord of the augmented 2nd on the 6th degree in minor
The chords by subposition: 9th and 11th chords

II. From the Handbuch (p. 28)

I. Fundamental chords of the first rank (all non-inverted chords found within the range of an octave)

1) consonant harmonic triad C-E-G, A-C-E.

2) dissonant harmonic triad B-D-F, C-E-G♯.

3) 7th chord G-B-D-F

All these are constructed in a series of ascending thirds.

II. Fundamental chords of the second rank (all chords by subposition)

1) the 9th chord E/G♯-B-D-F

2) the 11th chord C/G♯-B-D-F

3) the 13th chord A/G♯-B-D-F

III. From the Untersuchung (p. 16)

A. Classic chords (those which are based only in one key). These are divided into:

1) triads (Hauptaccorde), major and minor

2) related triads (Verbindungsaccorde), dissonant because of their position in the key, which are

a) minor diminished triads on the 7th degree in major

b) major augmented triads on the 3rd degree in minor

B. Fantastic chords (those which arise from the mixing of two or more keys).

He cites the previously discussed 7th chords B-D♯-F-A, D♯-F-A-C and asks which of the triads B-D♯-F, G♯-B-D, D♯-F-A, or E-G♯-B♭ has priority over the other. This, he says, may be answered by reconsidering the progression of fifths from which he derived his system of 21 tones. Since B and E were obtained before D♯ and G♯, the triad B-D♯-F has priority over the triad D♯-F-A.

These "mixed triads" are also mentioned in the Handbuch, but only perfunctorily and not as part of a system of chord classification.

In the Anleitung Marpurg develops a relational scheme of keys, according to which there are two kinds of harmonic relationship. The first is based on a similarity of triads; the second, on an agreement [Uebereinkunft] between notes. For example, the two triads C-E-G and A-C-E would not be related under the first condition, because one is major and the other minor; but because of the coincidence of the notes C and E they would be related under the second.

Marpurg then tabulates all the keys according to degrees of relatedness based on the progression of fifths from which he first derived his system of 21 tones. Thus, in major, G(B-D) is related to C(E-G) in the first degree but to D(F♯-A) only in the second degree [Anleitung, 57-62]. The complete table of relationships for all major keys is given below [Anleitung, 55].

	8	G♯	B♯	D♯	
	7	C♯	E♯	G♯	
Erklingende	6	F♯	A♯	C♯	
oder	5	B	D♯	F♯	
aufsteigende	4	E	G♯	B	
Töne	3	A	C♯	E	
	2	D	F♯	A	
Grad	1	G	B	D	
		C	E	G	(Grundharmonie)
Grad	1	F	A	C	
	2	B♭	D	F	
Erzitternde	3	E♭	G	B♭	
oder	4	A♭	C	E♭	
absteigende	5	D♭	F	A♭	
Töne	6	G♭	B♭	D♭	
	7	C♭	E♭	G♭	
	8	F♭	A♭	C♭	

Minor is tabulated in the same manner, using A(C-E) as the central key. Minor and major are related among themselves, but are they related to each other? Marpurg finds that they are always related in the first degree because of the agreement of the tones of the two scales. He remarks that relationships of the first degree between a major and a minor key mean an intervallic separation of a third, not a fifth as is the case in first degree relationships between two major keys or two minor keys.

Kirnberger occupies a curious position in the history of music theory. While his important contribution, his concept of essential and non-essential dissonance, is certainly of his own time, many aspects of his theoretical work belong to the preceding period. His views on essential and non-essential dissonance will be closely examined during a later section where they will be compared to those expressed by Marpurg in his Anhang über den Rameau- und Kirnbergerschen Grundbass. In the present section a resumé of certain of the outstanding features of his harmonic theory is given.

Kirnberger begins his Harmonie with a preface in which he expresses his impatience with the French penchant for foggy acoustical explanations of the origins of musical material. The first chapter then opens with this direct statement:

> The whole of harmony rests on only two fundamental chords, from which come all other chords . . . a) the consonant triad which may be major, minor, or diminished b) the dissonant essential 7th chord which may be the minor seventh with perfect fifth and major or minor third, or with diminished fifth and minor third, or the major seventh, perfect fifth, and major third . . .of these two the first is more perfect [Harmonie,3].

Both the Kunst and the Harmonie take up the materials of music in the same order as does Rameau (minus the initial proofs). Both treatises begin with chords and intervals, then deal with the construction of scales. The latter is dealt with more fully in the Kunst, where Kirnberger obtains from the 1st to the 40th partials the diatonic, the chromatic, and the enharmonic scales. As shown below, the diatonic scale is completed by the fourth octave, the chromatic by the fifth, while the sixth octave contains the quarter-tones of the enharmonic scale [Kunst II, 68].

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
C	c	g	c	e	g	x	c	d	e	f	g	a	x	b	c	(diatonic)

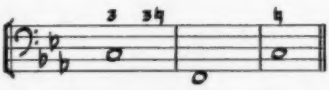
16	17	18	19	20		
c	c♯	d	d♯	e	etc.	(chromatic)

32	33	34	35	36	37	38	39	40			
c	c+	c♯	C♯+	d	d+	d♯	d♯+	e,	etc.	(enharmonic)	

But as we shall see later in the discussion of Marpurg's Anhang, Kirnberger is concerned more with the manner in which chords function in a key, with the manner of their progression, than he is with their structure or their acoustical origins.

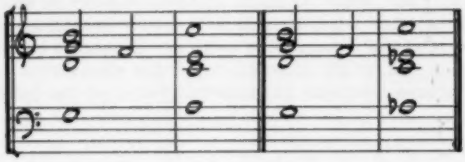
The chapter in the Kunst entitled "Remarks on the nature and use of chords . . ." deals with leading-tones and cadences. Of leading-tones he says: 1) the major third of dominant harmony must never be doubled [K, 35]; 2) if the tone B is in C major it must act as a leading-tone, but if it is in G major it need not. He remarks that although previous harmonists always ended a piece with a major triad, regardless of mode, at present it is not considered necessary. In Chapter VI, on periods and cadences, he augments these remarks. A perfect cadence is V^7-I, which is its most perfect form. Less perfect is V^6_5-I and V^4_3-I, and least perfect is V^4_2-I. A somewhat more perfect cadence is I-IV-I. However, when this cadence is used in the minor mode one must replace the minor third with the major shortly before the close and also in the cadential chord itself [Kunst I, 95]. In this as in many other instances Kirnberger reveals his sensitivity to unprepared chromatic changes which involve fundamental harmonies. Here the major third of the cadential tonic chord is prepared by a major third in a triad which, to use more modern parlance, serves as a secondary dominant embellishment to the subdominant triad.

Example 1.



A third type of cadence is that which the French call rompue. According to Kirnberger this is most successful when the third of the final chord is doubled [Kunst I, 99]:

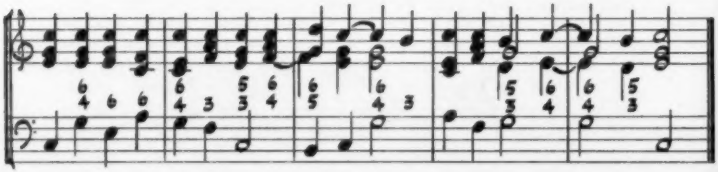
Example 2.



In Harmonie he gives a table of the best bass progressions. The strongest and best are by fifths and fourths, next by thirds and sixths, and finally, the weakest, by seconds.

Of considerable interest is the distinction which Kirnberger draws between two kinds of diminished triad. The triad on the second degree of a minor scale is vermindert. It is a consonant chord, any interval of which may be doubled. This is unusual in view of the cardinal rule of the time that the major sixth could never be doubled when accompanied by a minor third. The triad on the leading-tone (semitonum modi), however, is consistently referred to, not as vermindert, but as falsch.

A strong connection exists between Kirnberger's views on the six-four chord and those on essential and non-essential dissonance. The consonant six-four chord, like any essential dissonance, can occur either on a weak or on a strong beat. It may be taken without preparation and any note may be doubled. In fast eighth-note passages it is treated as passing and not figured. The dissonant six-four chord, like any unessential dissonance, can occur only on the strong beat — as a suspension or as an appoggiatura. It must be treated as a dissonance, with both fourth and sixth prepared and resolved. In the former instance the six-four chord represents a triad in second inversion; in the latter it is a triad with the fifth and third delayed by suspension or appoggiatura [Kunst I, 51-2; Harmonie, 13]. There is also a third case, in which the sixth may enter freely but the fourth is treated as a dissonance, as a suspension to the third. In this case the six-four chord represents a sixth chord whose third is delayed by suspension or appoggiatura [Grundsätze, 67]. Examples of all three may be seen in the passage below, which is taken from the Grundsätze.

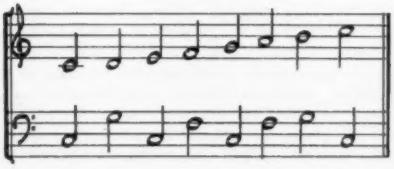
Example 3.

Marpurg's interpretation of Kirnberger's remarks on the six-four chord demonstrates the wide divergence between their points of view: "A six-four chord may be generated in two ways, one by inversion of a triad, the other by suspension. A triad may be a fundamental chord or not." Marpurg then goes on to ridicule Kirnberger's example of a 5-6 suspension in which an E-minor triad occurs at the point of suspension and subsequently resolves to a sixth chord over E. He asks: "What composer would ever think that the triads A-C-E or E-G-B could have a C triad as fundamental chord? Not even a double-contrapuntist [Anhang, 292]."

It was stated above that although Kirnberger's most important contribution to music theory (his definition of essential and non-essential dissonance) shows a progressive turn of mind, there are scattered throughout his writings elements of theories belonging to an earlier generation. For example, he consistently uses the older word Verwechslung instead of the contemporary Umkehrung, the standard German word for harmonic inversion;[3] and in the Grundsätze (p. 10) he suggests the use of the old German nomenclature for accidentals: all sharps.

Kirnberger shows a distinct preference for an unequal temperament in which one can distinguish the difference between keys. Equal temperament, he says, leaves us with only two differences in character, major and minor [Kunst I, 1-10]. He is still greatly concerned with the affective qualities of key and interval. The Kunst contains an interesting list of intervals and their "affection" [Kunst II, 103], as well as a table of the affective qualities of each of the modes; a chorale is provided in each mode [Kunst II, 51]. Obviously none of this would be discernable in equal temperament and Kirnberger deplores this loss.

Interesting sidelights on Kirnberger's concerns are offered by the frontispieces he selected for two of his books. The frontispiece for the Grundsätze is a C-major scale in the bass clef with the word "problema" above it. In the Kunst we find the answer [Kunst I, 25]:

Example 4.



The frontispiece to the Anleitung zur Singecomposition is an engraved emblem with the words "mi-fa et fa-mi est tota musica."

3. He does use Umkehrung in the Kunst, but only in connection with interval inversion.

JOYCE MEKEEL

The last of Marpurg's theoretical works contains the Anhang in which he discusses and attempts to refute Kirnberger's conception of the fundamental bass. It reads like an actual argument, for Marpurg has sprinkled the Anhang with liberal quotes and examples from Kirnberger's Gebrauch and Kunst. At the heart of the conflict in these discussions lies the different conception of essential and non-essential dissonance held by each man. When Marpurg attacks Kirnberger for misunderstanding the nature of the fundamental bass, it becomes evident that the real issue does not concern the fundamental bass but, rather, essential and non-essential dissonance. Kirnberger appears to use the fundamental bass to show the aural logic of a progression. This is definitely outside the proper realm of the fundamental bass as originally conceived by Rameau. Marpurg is quick to seize on the error and to pronounce Kirnberger's fundamental bass "not a real fundamental bass." Having done this, he is inclined to regard questions of essential and non-essential dissonance as side issues; they are important but they have little to do with the intrinsic nature of Kirnberger's fundamental bass. Thus, the battle lines are never clearly drawn, since Marpurg, by separating the issues of fundamental bass and essential and non-essential dissonance, stops just short of perceptive refutation of Kirnberger's fundamental bass. And on the other hand, because Kirnberger's conception of essential and non-essential dissonance was still in the formative stage, his reasoning is sometimes faulty or superficial. An evaluation of this passage-at-arms perhaps is best made after a presentation of the essentials of the argument — in the original words of the opponents insofar as possible.

Fortunately, both men are quite precise in their description of a fundamental bass. Marpurg entitles the preface in which he defines fundamental bass ". . . on the general difference between the fundamental bass of Rameau and that of Kirnberger" [Anhang, 229]. Here, as is always the case in Marpurg's writings, the debate is not between Marpurg and the opponent but between Rameau, represented by Marpurg, and the opponent. His definition reads as follows:

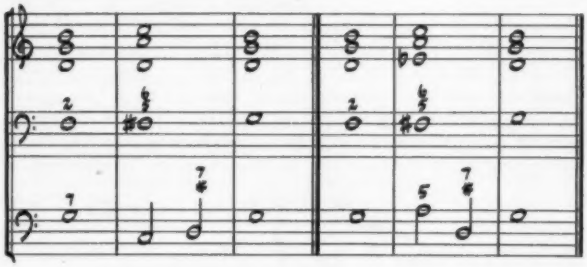
> By the word fundamental bass Rameau means a bass which is nothing more than a row of fundamental chords derived from the figured bass of a piece, a mixture of chords without the least connection. I say without the least connection, because in the exposition [Darlegung] of the fundamental chords, they are not to be considered in the manner of their progression; rather, each separate chord of the figured bass is reduced directly to its fundamental chord. Thus, it is immaterial whether a fundamental chord has a regular or an irregular connection with either the previous or the following fundamental chord, as it is likewise immaterial whether the fundamental bass-tone stands in regular or irregular relationship with the completed voices (Anhang, 232).

THEORIES OF KIRNBERGER AND MARPURG

In the Kunst Kirnberger has written a 3-voice fugue and has placed below it an analysis in the form of two basses (Ex. 5, p. 185).[4] One of these is a fundamental bass, but Kirnberger apparently feels that this is inadequate because it shows only the root-position chords. A second bass is needed to show the dissonances by suspensions and appoggiaturas. He explains his system thusly:

> The lowest of the three staves is what the French theorists call the fundamental bass. It contains the actual [wahren] fundamental chords, namely the triads and 7th chords upon which the harmony is based. The following staff shows the non-essential [zufalligen] dissonances, or appoggiaturas [Vorhälte] wherever such occur. On the top staff the figured bass shows which inversion of the triad or 7th chord has been used for each harmony. Along with this are given the appoggiaturas (Kunst I, 249).

Marpurg asserts that the fundamental bass of Kirnberger is not a pure fundamental bass but an "interpolated" bass [Interpolirbass] [Anhang, 276].

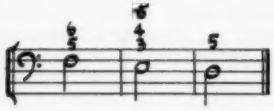
Example 6.

Of the foregoing example (Ex. 6) taken from Kirnberger's work, he says:

> The $\frac{6}{5}$ arises by inversion of the 7th chord D-F#-A-C. The diminished 7th chord F#-E♭-A-C is its own fundamental chord. He [Kirnberger] finds the progression from G-B-D-F to D-F#-A-C unharmonic because the seventh, F above G, is not first resolved. Since this resolution is possible in many forms, there are many forms of fundamental bass; as many as there are possible resolutions... What comes of this? Kirnberger's fundamental bass is not a real fundamental bass.... The pure fundamental bass cannot contain more or less than what is contained in the written voices, and is possible only in one form [Anhang, 276-7].

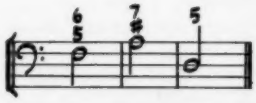
4. Additional analyses are to be found at the end of Die Wahren Grundsätze zum Gebrauch der Harmonie. These analyses are of the B-minor Fugue from Bach's Well-Tempered Clavier, Vol. I, and the A-minor Prelude from Vol. II of the same work. The analyses were carried out by Schulz, according to his own testimony, under the supervision of Kirnberger [2, 97].

If Kirnberger does indeed regard his bass as "what the French theorists call the fundamental bass," Marpurg certainly has proved him to be in error. His last sentence contains the essence of the French point of view. The fundamental bass, as originally conceived by Rameau, cannot contain more than what is contained in the original example. Therefore, in this sense Marpurg is correct when he calls Kirnberger's fundamental bass an "interpolated" bass.

In the Gebrauch Kirnberger explains his interpolations in the fundamental bass, asking first: "What harmonies are fundamental to this passage?:"

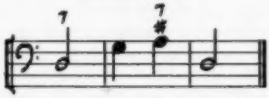
Example 7.

Are they those of Rameau?:"

Example 8.

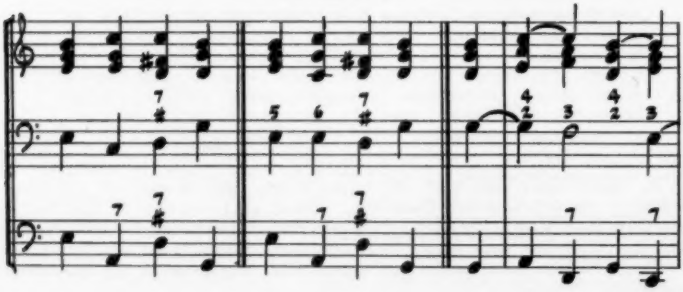
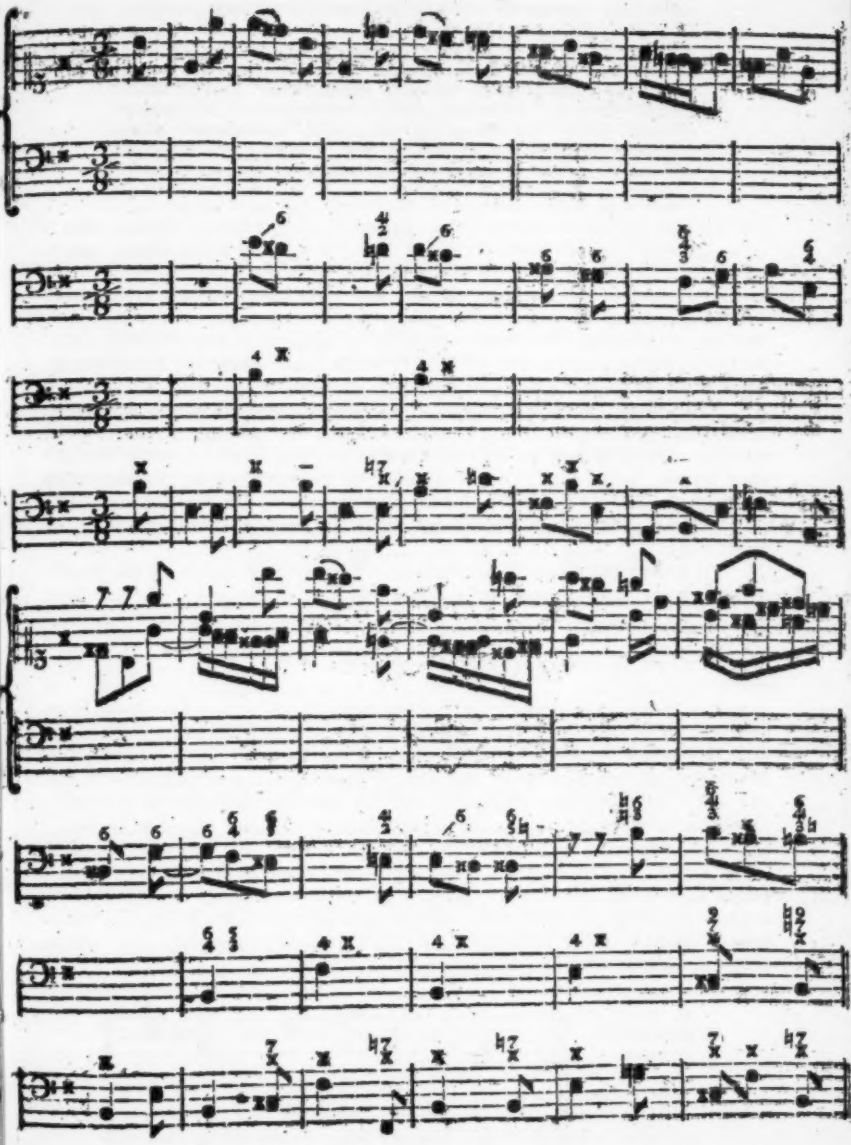


"From this one would never guess that the first two chords could follow one another; does one not sense that between the first and second chord there is an ellipsis of resolution [Uebergang der Resolution], and that the following must necessarily be the harmony [Gebrauch, 41-2]?"

Example 9.

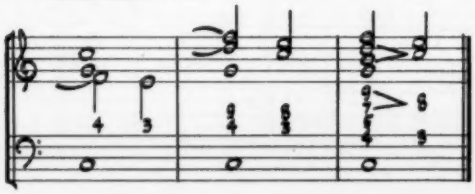


Further amplification is provided by Kirnberger's comment on the following chord successions:

Example 10.

Example 5.

> The rule cannot be repeated too often that one must pay close attention to the progression of every chord, for through progression the same chord is often completely different than what it seems. Therefore, we have constructed for the uninitiated the following examples of different chord progressions, along with their fundamental chords. Although their explanation is already evident from the foregoing, they will disconcert those who have an imperfect grasp of the theory of harmony or who lack a sense of natural progression...[Gebrauch, 104].

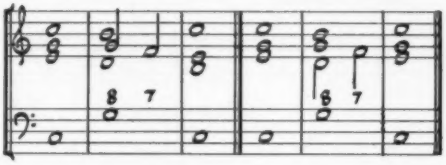
Marpurg's comment on this passage is: "It is perfectly correct that if in a figured bass a consonant chord is changed to a dissonant chord, the fundamental harmony is also changed, just as if a dissonant chord were changed to a consonant chord. But what justifies this alteration? The fundamental bass should not say what the composer could have said had he so wished, but rather what he actually did say [Anhang, 285]." Although Kirnberger is in error in this instance, Marpurg's last statement again reveals his real difficulty in comprehending Kirnberger's point of view. Marpurg regards the fundamental bass as an exact, literal indication of the root of each successive vertical combination of pitches. Kirnberger, as will be seen even more clearly in the discussion below, feels that it is necessary to accept melodic explanations for certain complex combinations, and therefore his fundamental bass often takes into consideration not only the written note but also its resolution.

A primary reason for Kirnberger's erroneous usage of the fundamental bass can be seen in his definition of dissonance. In the first part of the Kunst he separates dissonances into two groups: essential [wesentlich] and non-essential [zufällig]. The non-essential are described first, in terms of single suspensions 9-8, 7-6, and $\frac{5}{4-3}$, then double suspensions $\frac{9-8}{4-3}$, $\frac{9-8}{7-6}$, and $\frac{6-5}{4-3}$, of which Kirnberger says: "In order to make the entrance of the harmony more attractive from time to time, or to arouse in the hearing a longing after the same, an occasion can arise in which the Grundton is not struck; rather, something is omitted in order to give correspondingly greater satisfaction to the ear shortly thereafter [Kunst I, 127]." A similar passage in the Harmonie is more explicit: "In the progression from one chord to another, any tone, regardless of the voice in which it lies, either alone or with other tones, can be delayed from above or below by a tone which precedes it, a tone which dissonates and soon thereafter enters its essential position, or resolves. In this way there arise a number of dissonant chords whose resolution is to the same Grundaccord, of which they are appoggiaturas [Harmonie, 8]."

Example 11.

Marpurg's comments upon this passage further indicate the limited extent of his comprehension of Kirnberger's thesis:

> It is known that all chords which have the same origin [Ursprung] are related, and that all related chords can be substituted one for another.... Can these chords [Ex.11] be used one for another? No,... none of these chords are related; therefore they do not have the same origin. And if they do not have the same origin, the alleged Grundaccord, namely, the bass-tone C with the major triad, is incorrect. One must not derive chords by considering the way in which the first musicians came upon the notion of dissonances, or by considering the way in which preparation and resolution of dissonances can be explained, but rather by considering the way in which nature presents them...[Anhang,288].

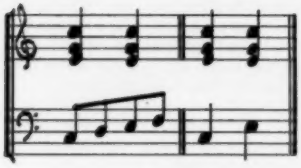
Further on in the Kunst Kirnberger comes directly to the matter of essential dissonance: "...since these suspensions are not necessary we will call them non-essential dissonances. In addition to these dissonances there are others of a different sort which one can call essential, because they do not take the place of a consonance, to which they immediately yield, but rather maintain their own positions. Their origin can be represented in the following way [Kunst I, 30]:"

Example 12.

Kirnberger subsequently strengthens and clarifies this definition: "One can take as a general rule that after every essential dissonance the bass ascends four tones or descends five tones and has a triad as its harmony unless an inversion of this chord is taken [Kunst I, 64]."

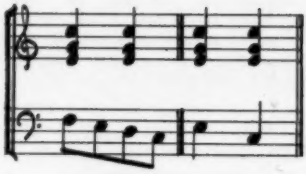
Marpurg's definition of essential and non-essential dissonance reads as follows:

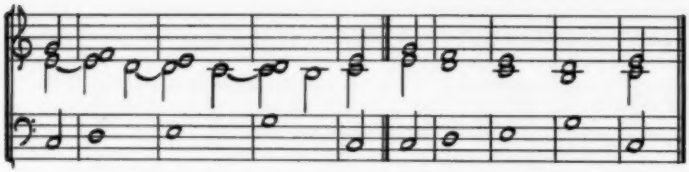
> Every dissonance which is used purely for the sake of the melody — and with regard to the harmony could be there as well as not — is called a non-essential dissonance in the theory of harmony. Of such nature are all passing and changing-notes, or, as they are also called, regular and irregular passing-notes. Thus the passing-notes and the changing-notes shown here [Exx.13,14 on p.188] are non-essential dissonances. Every dissonance which is there for the sake of melody as well as harmony is called an essential dissonance. Of such nature are: 1) those dissonances which result from suspension [Exx. 15,16 on p.188] 2) those dissonances which result from the anticipation of a regular passing-note [Exx.17,18,19, 20 on p.189] [Anhang,240].

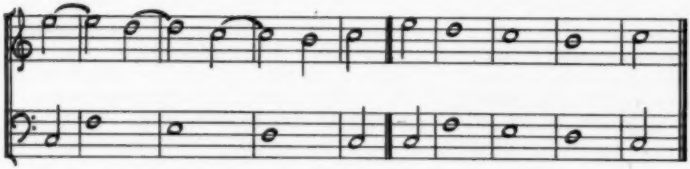
Example 13.



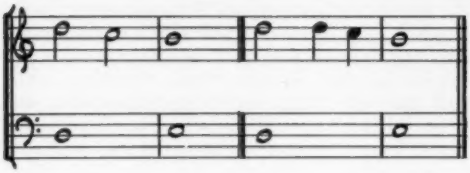
Example 14.



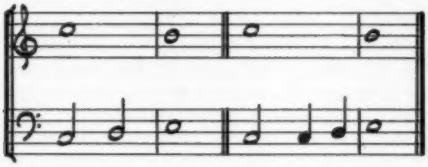
Example 15.

Example 16.

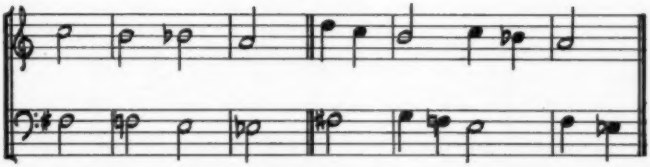


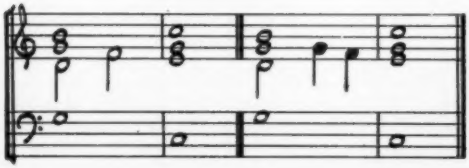
Example 17.



Example 18.



Example 19.

Example 20.

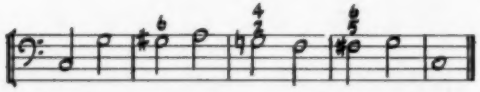


In Harmonie Kirnberger further specifies his first definition of essential and non-essential dissonance by appending two additional methods for identifying non-essential dissonance. Essential dissonances fall either on weak or on strong beats, whereas non-essential dissonances fall only on strong beats. This is interpreted by Marpurg to mean that 7th chords may fall on either beat, but that 9th and 11th chords may occur only on the strong [Anhang, 295]. Further, Kirnberger says that the resolution of non-essential dissonances occurs over the same bass note, whereas essential dissonances resolve over a different bass note. If a seventh resolves to a sixth it is non-essential; if not, it is essential [Harmonie, 16]. To this, Marpurg replies: "In general the minor seventh may resolve on the same bass or on a different bass. Thus, it remains an essential dissonance [Anhang, 304]." Kirnberger says that it is incorrect to explain G♯-B-D-F as a fundamental chord or to add a third beneath it as its real root if it enters freely and resolves on the sixth over the same bass note [Harmonie, 19]. Marpurg replies: "This is impossible since a 7th chord is a 7th chord the world around [Anhang, 309]." Kirnberger goes on to say that this chord, even if it were to resolve to a chord on a different bass note, could be regarded as a chord consisting of a ninth and seventh from a root (E), the ninth being an appoggiatura and the seventh essential [Harmonie, 19]. Marpurg does not really understand this, and his only response is an ill-tempered paraphrase of Kirnberger's definition of essential and non-essential dissonances according to bass-progression. He explains Kirnberger's chord as the first inversion of an augmented second F-G♯-B-D on the sixth degree of A minor with E as a subposed root [Anhang, 313, 318].

Kirnberger's views on the six-four chord have already been dealt with. Marpurg consistently presents the root of the triad as the fundamental bass of the six-four chord. He does not take into account its resolution, even in the case of the tonic six-four. He quibbles with Kirnberger's term "dissonant six-four" as applied to the tonic six-four, saying that a consonant triad is consonant in all inversions [Anhang, 298].

Another interesting point of difference comes up at the end of the Anhang. Kirnberger has said that the following bass can be analyzed completely in C major because non-essential accidentals do not change the key.

Example 21.



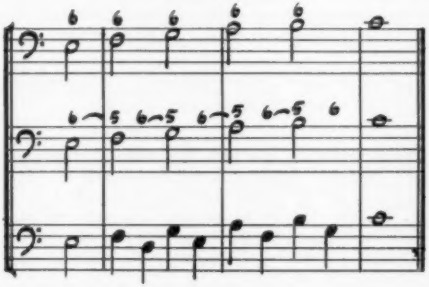
Marpurg holds that a modulation does take place, albeit a passing one, since there is no G♯ or F♯ in C major [Anhang, 313].

Thus, Marpurg and Kirnberger have expressed diametrically opposed points of view on two important questions:

1) Does chord progression affect the determination of the fundamental bass? Kirnberger says yes. Marpurg says no.

2) Are suspensions essential or non-essential dissonances? Kirnberger says they are non-essential. Marpurg says they are essential.

Marpurg is forced to consider suspensions as essential dissonances because of his views on the structure of 9th chords. (The ninth must be viewed as an essential dissonance to conform to Rameau's "melody from harmony" principle.) By regarding suspensions as essential dissonances Marpurg is forced to consider each vertical combination of pitches in isolation. To Kirnberger the fundamental bass, in association with this view of suspension and essential dissonance proved to be an inadequate and restricted tool of harmonic analysis. Marpurg, committed as he is to his views of suspensions and essential dissonance, is not free to hear the longer span of harmonic relationships which Kirnberger appears to comprehend. The length of these spans is sustained by what to Kirnberger seems to be the most natural harmonic progression, up a fourth or down a fifth. He has defined essential dissonance in terms of this bass progression, and with very few exceptions his "interpolations" and Uebergänge der Resolution are made in favor of "that progression which makes the harmony more natural." In analysis his predilection for this progression sometimes leads him astray, for example in his analysis of the following passage:

Example 22.

... it is impossible that these successive sixth chords are inversions of triads. In such a short time, how can we have E major, D minor, E minor, etc. which are incapable of possessing such a close [temporal] relationship?... the following analysis of these six chords shows that they are nothing less than six chords with an anticipation in the upper voice, and are thus built from a natural progression of fundamental harmony [Harmonie, 45].

The fundamental bass for the extended example in the Kunst (Ex. 5, p. 185) moves almost entirely in fourths and fifths. Kirnberger has analyzed the passage to show a series of dominant-tonic relationships. And although the fundamental bass he has given is a travesty of the original conception of fundamental bass, it is completely logical aurally, to modern ears at least.

For all their differences, Kirnberger and Marpurg have two characteristics in common. First, neither was an acoustician. The derivation of the materials of music was relatively unimportant to them. In the preface to the Gebrauch Kirnberger expresses extreme annoyance with foggy French mathematics and begins his book with the unequivocal statement that the basic chords in music are the triad and the 7th chord. Although Marpurg was more interested in acoustical problems than was Kirnberger his theoretical treatises do not treat them in great detail. Both men were practical theorists concerned primarily with immediate problems of harmony and analysis. Finally, Marpurg and Kirnberger have equally little affinity for the theories of Rameau: Marpurg by virtue of misunderstanding (and misrepresenting) them, Kirnberger by virtue of his more advanced point of view.

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A NEW METHOD OF REPRESENTING TONAL RELATIONS

by

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In the following article I shall try to explain a new system for representing tonal relations, or, more precisely, a diagram which explains to a certain extent the psychological effect of tonal relations.

As we know, ordinary musical notation is based on the diatonic scale with its seven unequal steps. Each graphically equal ascent in the symbols of our notation represents an ascent in the unequal steps of this scale. The graphic symbol of a second is the same for any second, be it major, minor, augmented, or even diminished. The same, of course, is true for any group of intervals, thirds, fourths, etc. This grouping under the same heading of intervals which differ with regard to size, vibration-ratio, grade of consonance, and psychological effect — for example, perfect and augmented fourths — has a certain practical value, but it makes sense only in limited measure and only in relation to the diatonic scale.

In addition, there is an unnecessary and confusing duplication in the use of two or three names for an interval. For instance, the interval which spans three semitones is named minor third, augmented second, or doubly-diminished fourth. Thus, one can understand the efforts which have been made to negate all these confusing notions by establishing a notation which considers only the number of semitones in each interval. Yet, I see certain dangerous consequences of this simplification, for the essential difference between, let us say, F♯ and G♭ is greater from a certain point of view than is the difference between F♯ and G♮. In a notation which would express only the "size," i.e. the number of semitones within the interval, there would be no indication whatsoever of this important difference.

Elsewhere I hope to have the opportunity to write at greater length about the names prime, second, third, etc. It might be desirable to exchange them for others. We use them here since they are commonly understood, yet it is definitely not my intention to equate three intervals which bear three different names, although all have the same number of semitones. This identification, which is recommended by some modern theoreticians, is bound to cause lack of understanding as to the significance of the tones, and the effect of this on the future of music could be very detrimental. Experiments to cancel the signs ♯ and ♭ in a notation of twelve equal tones are also harmful simplifications — at least in regard to music that is in some measure based on harmonic proportions or on other harmonic considerations.

Thus, the question arises as to how one explains and represents clearly the difference between one interval and another, which are

seemingly identical (according to the number of halftones) but which are differently notated, e.g. the minor second and the augmented prime. A suitable explanation would have to be an audible one, since without a corresponding musical experience the value of any explanation will remain abstract. This experience — the experience of the musical content — is conveyed to us only through the ear. For example, if we begin from D and proceed to the note a semitone above, that note will sound like E^b, especially if we play the tones C and G with it. However, if after playing the D we accompany the note a semitone above it with B and F#, it will immediately signify D#. Thus, in the first case one experiences the minor second, in the second case the augmented prime. Yet, this alone is not sufficient, for one feels the difference, but still does not understand it intellectually. Therefore, after the acoustical presentation, we proceed to a mathematical explanation. It will be to our further advantage if we can add a graphic representation, our intellectual understanding being related more to the eye, with its greater ability to grasp wider planes at a glance.

From the above it follows that the visual aspect of any interval in our ordinary music notation is not a true expression of the musical experience which it evokes and of the relationship between its tones. (This relationship is determined, as commonly known, by their vibration-ratio.) The interval F-B in the G clef and D-G in the F clef look completely alike, but have extremely different musical meanings, not so much with respect to pitch as with respect to vibration-ratio. Similarly, both E-F and F-G are expressed by the same ascent of the symbols of notation, while in reality they are, as we will see later, opposite harmonic directions and differ in size by fifty percent, E-F comprising one semitone, F-G two semitones. This discrepancy is sometimes responsible for a lack of lucidity and prevents laymen, students, and to a certain extent professional musicians, from understanding the real meaning of tonal relations.

The notational method proposed here, a diagramatic method, permits the adequate and faithful expression of relations between the tones of an interval, chord, scale, or any other group of tones. The pedagogical, theoretical, and scientific value of the diagram lies in its capacity to deepen our understanding of the psychological effect of these groups and to provide a perspicuous means for the graphic presentation of tones. Obviously the diagram is not a substitute for ordinary music notation, which, in addition to pitch, expresses duration. The diagram expresses size and tonal relationship. Certain associations existing between movements and directions of moving bodies, in relation to the surrounding space on the one hand and "tonal movement" on the other hand guided me in finding this system of notation. This experience of tonal space should be strengthened and developed from a purely sensory to a conscious factor. It would yield positive results for musical education and understanding.

When we hear a musical interval we distinguish between two factors, from the tonal point of view: first, the more obvious "melodic" factor which depends on the frequency-difference between tone and tone (the "size" of the interval), and the harmonic factor, which depends on

Diagram 1.

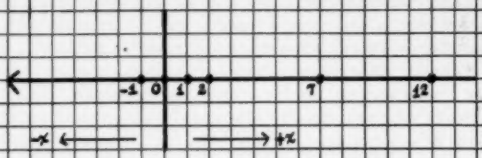


Diagram 2.

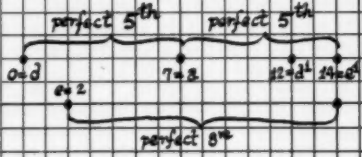


Diagram 3.

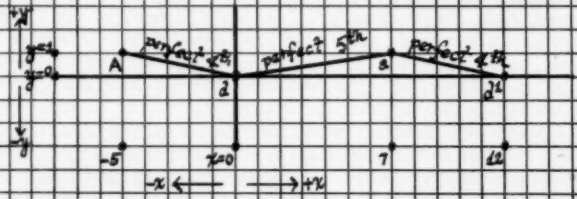


Diagram 4.

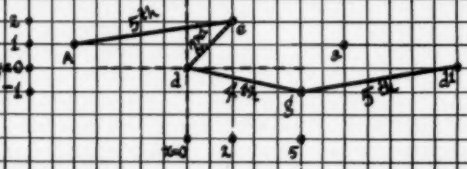


Diagram 5.

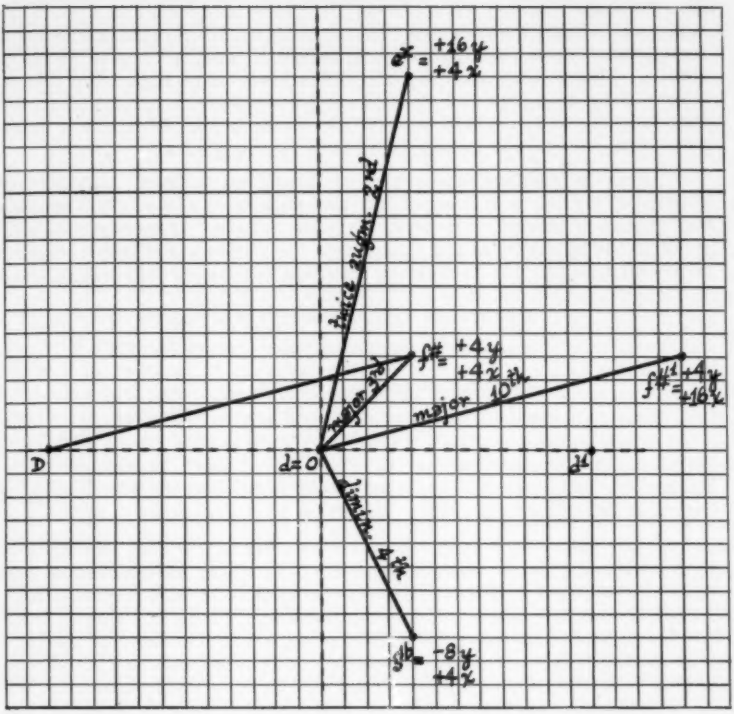
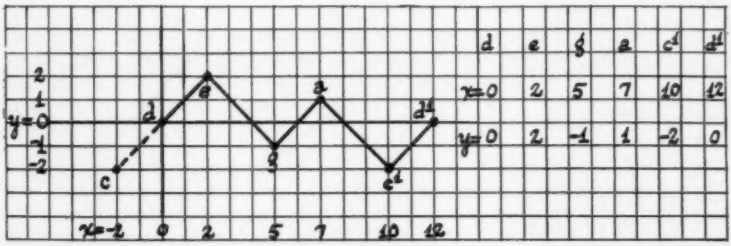


Diagram 6.



the vibration-ratio of the tones. Thus the simplest vibration-ratio (the one expressed by the simplest numbers) of two different tones, 1:2, generates the octave, which from the "harmonic" point of view is the same tone. In all musical cultures people with different kinds of voices, for instance, father and son singing together, sing in the interval of an octave. This means that the child sings tones much higher (an octave) from a melodic point of view. But everybody feels, nevertheless, that they sing the same. This proves that tones in the relationship of the octave are identical from the "harmonic" point of view.

For the graphic expression of these two factors, melodic and harmonic, we use a system of two coordinates, x and y. The graphic expression of the melodic factor is quite simple. If we base the diagram on the partition of the octave into the twelve equal parts common in Western music,[1] the coordinate x serves to express this factor, thus:

1 semitone (minor second) = 1x

2 semitones (major second) = 2x

7 semitones (perfect fifth) = 7x

12 semitones (perfect octave) = 12x

Movement to the right means + x, "melodic ascent." Movement to the left means - x, "melodic descent." This is similar to movements of ascent or descent on the piano. (Diagram 1, p. 196).

The determination of the harmonic factor, which will be expressed in y, is more complicated. As long as the experience of this factor is not present, that is, as long as the hearer differentiates only the factor x, there is no musical understanding. There are only ascents and descents with no musical significance, as in the cries of animals or in human speech. And ultimately it becomes evident that the factor y determines the size of the factor x. The two are interdependent. We have mentioned the phenomenon of the octave. What determines the distance between the octave and its root? Why is it exactly 12x (in our system of tuning)? And what determines the size of 1x (that is, the minor second or augmented prime)? Neither tonal system, tonal organization, scale, nor tonal communication are possible without the factor y. Musical communication must be based upon some kind of tonal convention which, in turn, is based upon the factor y. In addition to the octave we find the interval of the perfect fifth and the major second (the "whole tone") in all parts of the world. When we reflect upon these matters we understand that the wish to ascend or descend melodically gives only the direction; the more exact size of the required interval is determined by the feeling that we have reached a congruent tone, that is, a tone which stands in a legible relation (near or far) to the tone of origin.

1. It is possible to present different partitions of the octave in similar kinds of diagrams, as long as these are based on musical proportions and not only on quantitative divisions. It is even possible to express all physical tones in a three-dimensional diagram, but this lies outside the scope of the present paper.

In other words, it is the factor y which determines the size of, let us say, the fifth (approximately 700 cents), because only this tone stands in the simple vibration-ratio 2:3 to the tone of origin. And only that factor determines the size of the major second (approximately 200 cents), i.e. the result of two fifths minus an octave (see Diagram 2, p. 196).

d = 0c	fifth	702c
a = 702c	+ fifth	702c
e = ? c		1404c = e^1
	- octave	1200c
	major second	204c = e

The vibration-ratio of this interval is $(2:3)^2 = 8:9$. In a similar way y determines the size of every interval.

Y also determines whether, from the harmonic point of view, a tone is to be found above (+y) or below (-y) in relation to another tone. The simplest ratio after the octave (1:2) is 2:3 (= 1:3 when we consider what was said above about the identity of the two tones of the octave), that is, the perfect fifth. We always feel the tone expressed by the smaller number 2 (= 1 = 4, its octaves) as the lower tone from the harmonic viewpoint, and the tone expressed by 3 (= 6 etc.) as the higher.

Let us take again the tone d as zero point of our system of coordinates, x = 0 and y = 0; x of d^1 is 12x, but y of this tone is still y = 0, the tones of the octave being identical from the harmonic (y) point of view. The x of a, the perfect fifth above, will be 7x and its y is +1y. The reason for this: y shall express the harmonic relation. The perfect fifth is the simplest possible harmonic relation and, as explained above, when its root is considered 0, its upper tone from the melodic (x) viewpoint will also be the upper from the viewpoint of y and will receive the designation +1y. The x of A (perfect fourth below d) is -5x, yet its y remains again +1y, being identical with a from the harmonic viewpoint.

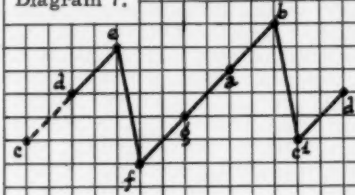
For the sake of comparison:

A	x = -5,	y = +1
d	x = 0,	y = 0
a	x = + 7,	y = +1
d^1	x = +12,	y = 0

This shows, taking d as 0, that every d (see Diagram 3, p. 196) independent of the octave in which it appears, has the indication y = 0 and every a, the indication y = +1.

It becomes manifest that in the perfect fifth the indication of x and y are parallel in the sense that the tone with the lower indication of x is also the lower regarding y; this means that the tone with the positive indication of x is also positive in respect to y. This is not the case

Diagram 7.

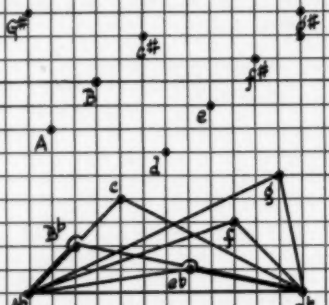


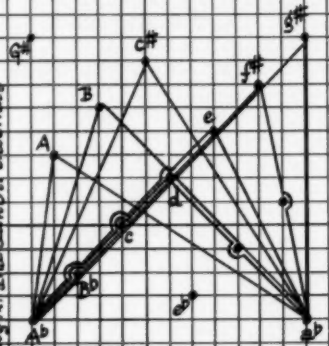
	c	d	e	f	g	a	b	c1
x=	-2	0	2	3	5	7	9	10
y=	-2	0	2	-3	-1	1	3	-2

if c is considered 0 - then is

	c	d	e	f	g	a	b	c1
x=	0	2	4	5	7	9	11	12
y=	0	2	4	-1	1	3	5	0

Diagram 8.

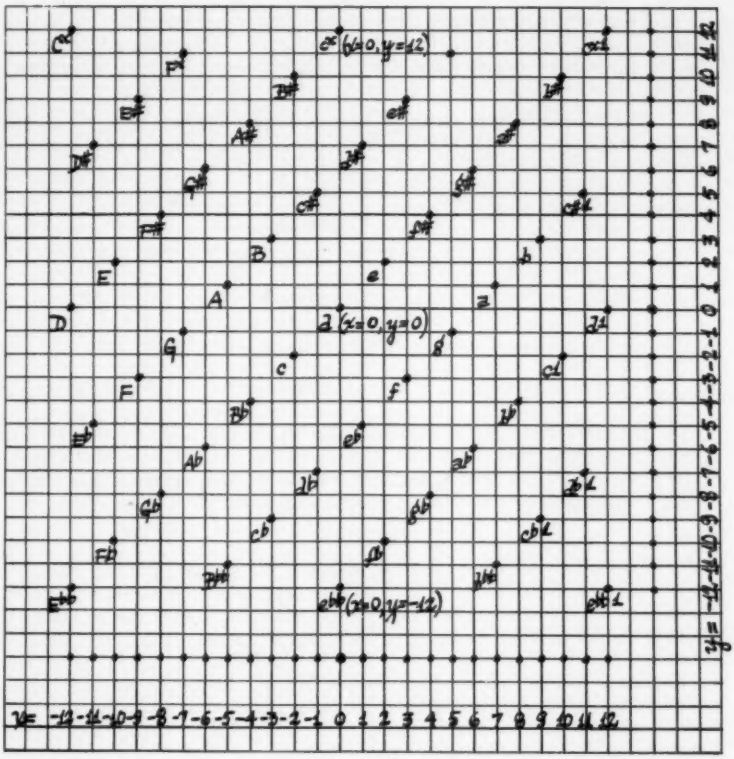




zig-zag. straight. upright intervals

Y=0	x=0	Ab Ab	perfect prime	
	x=12	Ab ab	"	8ve
Y=1	x=5	eb ab	"	4th
	x=7	Ab eb	"	5th
Y=2	x=2	Ab Bb	major	2nd
	x=10	Bb ab	minor	7th
Y=3	x=3	f ab	minor	3rd
	x=9	Ab f	major	6th
Y=4	x=4	Ab c	major	3rd
	x=8	c ab	minor	6th
Y=5	x=1	g ab	minor	2nd
	x=11	Ab g	major	7th
Y=6	x=6	Ab d	aug.dim.	4th
	x=6	d ab	dim.	5th
Y=7	x=1	Ab A	aug.dim.	prime
	x=11	A ab	dim.	8ve
Y=8	etc.			
Y=9				
Y=10				
Y=11				
Y=12	x=0	G# ab	dim.	2nd
	x=12	Ab G#	aug.dim.	7th

Diagram 9.


C𝄪
E𝄪 (x=0, y=12)
F𝄪
B𝄪
E𝄪
A𝄪
D𝄪
G𝄪
C𝄪
F𝄪
B
E
A
D
G
C
F
B♭
E♭
A♭
D♭
G♭
C♭
F♭
B♭♭
E♭♭
d (x=0, y=0)
e♭♭ (x=0, y=-12)
y= 12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2 -3 -4 -5 -6 -7 -8 -9 -10 -11 -12
x= -12 -11 -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12

with the perfect fourth. Here x and y point to opposite directions: d = 0, a = +7x +1y, but A = -5x +1y. The tone A is the lower in respect to x but the higher in respect to y. This fact is also confirmed by the well-known feeling that the root of the fifth is its lower tone, that we have to descend to it (melodically, i.e. in x). Yet, on the other side, we feel that the root of the perfect fourth is on top — as if it stood on its head — and we ascend to its root.

Take the tone e as the fifth of A. That means y = 1 + 1 = 2. But also its x will be 2 (two halftones above d = 0). Now take g. Its x = +5 but its y = -1, g being the first lower fifth (below d). (see Diagram 4, p. 196).

The factor y therefore is measured by the number of perfect fifths necessary to extend from one tone to another (without regard to the octave in which they appear): ascending fifths +y, descending fifths -y or the number of fifths between the two tones $\pm$ y. For instance, if d is 0 then in the case of

d to f♯	x = 4	y = $\pm$4	major third	f♯ = +4y
d to g^{b}	x = 4	y = $\mp$8	dim. fourth	g^{b} = -8y
d to e$^{\#}$	x = 4	y = $\pm$16	doubly aug. second	e$^{\#}$ = +16y
d to f$^{\#}$	x = 16	y = $\pm$4	major tenth	f$^{\#}$' = +4y

Thus, $\pm$4y indicates a harmonic distance of four fifths between two tones; +4y means that from our tone of origin we had to ascend to the "harmonic height" of four fifths; -4y means we had to descend from the tone of origin a distance of four fifths. See Diagram 5 on p. 197.

Pythagoras was the first to explain the pentatonic and diatonic scales according to fifths. These scales are represented in Diagrams 6 and 7. Later the explanation of the diatonic scale was based on a different supposition. Instead of building up fifths, an arrangement of three triads was taken (three major triads in the major and three minor in the minor scale). In addition to the fifths, these chords are composed of major and minor thirds or their inversions. We find also in these intervals the feeling which orders the tones as higher and lower from the harmonic (y) point of view. The major third is an expression of the relation 4:5[2] — for instance D = 4 and F$^{\#}$ = 5. (Here these numbers designate neither x nor y, but are the expression of the vibration-ratio.) According to the principle which guided us before (smaller number = lower tone, higher number = higher tone), D has to be the lower and F$^{\#}$ the higher tone with reference to y. Yet, we also reach F$^{\#}$ by four ascending fifths from D. There is therefore identity of the directions when comparing diatonic derivation (4:5) with the Pythagorean

2. For the sake of convenience from here on, intervallic calculation based on pure thirds will be called the diatonic calculation or interval, and the reckoning based on fifths will be called the Pythagorean calculation or interval.

Diagram 10.

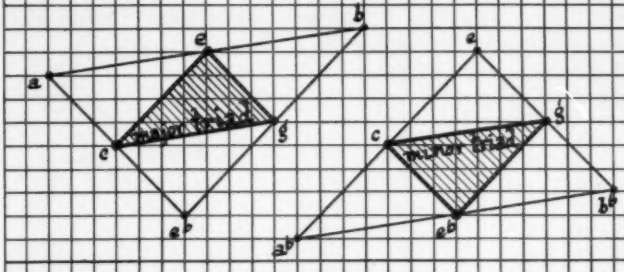


Diagram 11.

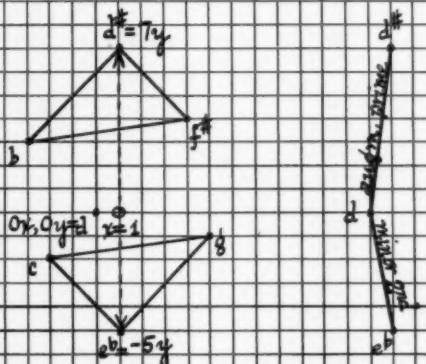


Table 1.

Arrangement in fifths (Pythagorean intervals)			Arrangement in combined deduction of intervals (Diatonic intervals)			
Fifths				Fifths	Major thirds	Major sixths
"	+17	Bx	Bx	1	4	
"	+16	Ex	Dx		2	2
"	+15	Ax	Ax		3	1
"	+14	Dx	Ex		4	
"	+13	Gx	Gx	1	3	
"	+12	Cx	B		1	2
"	+11	Fx	Fx		2	1
"	+10	Bx	Cx		3	
"	+ 9	E	E	1	2	
"	+ 8	Ax	G	2	1	
	+ 7	D	D		1	1
	+ 6	G	A		2	
	+ 5	C	C	1	1	
	+ 4	F	E	2		
	+ 3	B	B			1
	+ 2	E	F		1	
	+ 1	A	A	1		
	0	D	D			
	- 1	G	G	1		
	- 2	C	Bb		1	
	- 3	F	F			1
	- 4	Bb	C	2		
	- 5	Eb	Eb	1	1	
	- 6	Ab	Gb		2	
	- 7	Db	Db		1	1
	- 8	Gb	Ab	2	1	
	- 9	Cb	Cb	1	2	
	-10	Fb	Ebb		3	
	-11	Bbb	Bbb		2	1
	-12	Ebb	Fb		1	2
	-13	Abb	Abb	1	3	
	-14	Dbb	Cbb		4	
	-15	Gbb	Gbb		3	1
	-16	Cbb	Dbb		2	2
	-17	Fbb	Fbb	1	4	

ascending (+y)

descending (-y)

Table 2.

x	Y(-6 to +6)		Y(0 to +12)		Y(0 to -12)		Y(12 to 24)		Y(-12 to -24)	
= 0	0	d	0 12	d $c^{\#\#}$	0 -12	d e^{bb}	12 24	$c^{\#\#}$ $b^{3\#}$	-12 -24	e^{bb} f^{3b}
= 1	-5	e^{b}	7	$d^{\#}$	-5	e^{b}	19	$c^{3\#}$	-17	f^{bb}
= 2	2	e	2	e	-10	f^{b}	14	$d^{\#\#}$	-22	g^{3b}
= 3	-3	f	9	$e^{\#}$	-3	f	21	$d^{3\#}$	-15	g^{bb}
= 4	4	$f^{\#}$	4	$f^{\#}$	-8	g^{b}	16	$e^{\#\#}$	-20	a^{3b}
= 5	-1	g	11	$f^{\#\#}$	-1	g	23	$e^{3\#}$	-13	a^{bb}
= 6(= -6	+6 -6	$g^{\#}$ a^{b}	6	$g^{\#}$	-6	a^{b}	18	$f^{3\#}$	-18	b^{3b}
= 7(= -5	1	a	1	a	-11	b^{bb}	13	$g^{\#\#}$	-23	c^{3b}
= 8(= -6)	-4	b^{b}	8	$a^{\#}$	-4	b^{b}	20	$g^{3\#}$	-16	c^{bb}
= 9(= -3)	3	b	3	b	-9	c^{b}	15	$a^{\#\#}$	-21	d^{3b}
= 10(= -2)	-2	c	10	$b^{\#}$	-2	c	22	$a^{3\#}$	-14	d^{bb}
= 11(= -1)	5	$c^{\#}$	5	$c^{\#}$	-7	d^{b}	17	$b^{\#\#}$	-19	e^{3b}
= 12(= 0)	0	d	0 12	d $c^{\#\#}$	0 -12	d e^{bb}	12 24	$c^{\#\#}$ $b^{3\#}$	-12 -24	e^{bb} f^{3b}

derivation $(2:3)^4$ of any interval. This is also confirmed by the fact that there is no other name for a major third, be it the result of either of these ways of thinking. Not so with enharmonic intervals: with, for instance, $F^{\sharp}$ and $G^{\flat}$, where different names and designations are necessary because of the opposite harmonic directions of these tones. Also in the case of the interval of the minor third 5:6 there is identity of direction in these two ways of reckoning: D = 5, F = 6 = 3 (octave). This means that F is the lower tone from the harmonic viewpoint and D the upper. Here again, x and y point in different directions; but, if we take the inversion of the minor third, the major sixth, the two directions will again be parallel, and we understand now that y of any interval is identical with the y of its inversion. This is confirmed also by the Pythagorean calculation: f is the third fifth below d.

d y = 0

f y = -3

We see that by determining the y we can confine ourselves to the Pythagorean calculation. It alone will suffice to give an adequate position to any tone, to determine its "harmonic height" in our experience of tonal space. In the Pythagorean as well as the diatonic way of reckoning, it is always the fifth and its inversion which is the strongest and nearest harmonic relation in ascent as well as in descent. Thus, it will always remain the main measuring rod. The difference will be that in the Pythagorean calculation the nearest second is the major second, which is fourth in the diatonic reckoning, while the nearest second in diatonic reckoning is the major third, which is fourth in the Pythagorean calculation. In both cases the minor third will be number 3. There seems to be a constant interrelation which can be deduced from Table 1 (p. 204). The Pythagorean intervals follow the row of consecutive fifths (number of y), while the diatonic intervals follow the sequence fifth, major third, major sixth (= minor third), two fifths, fifths plus major third, and so on, while leaving out intervals which appear in an earlier stage, for instance, fifth plus minor third = minor seventh. From the point of view of y, this is identical with the major second already obtained by two fifths. In comparing the names obtained in the diatonic calculation with the ones obtained in the Pythagorean calculation we see a simple connection between the two: the second, sixth, tenth, etc. symbol in the Pythagorean calculation is identical to the fourth, eighth, twelfth, etc. symbol in the diatonic calculation and vice-versa. It is possible to express this as a mathematical formula: S = symbol, pt = Pythagorean, dt = diatonic, n = the number which the particular interval represents in the range of the particular table:

Spt 4n-2 = Sct 4n; Spt 4n = Sdt 4n-2;

Spt 2n-1 = Sdt 2n-1

(Spt 0 must equal Sdt 0).

It is interesting to observe that whenever the x of a tone is even, the directions of x and y are parallel, but whenever the number of x is

odd, the directions are opposite.

Further, it is possible to construct a formula which shows how to calculate different y's from a given x:

$$Y = f(X) = (X \pm n \times 12) - (-1^{X} \times 3-3)$$

Simplified, the formula would read:

(1) the x being an even number, $Y = (x \pm n \times 12)$

(2) the x being an uneven number, $Y = (x \pm n \times 12) - 6$

A practical example: (1) when we hear an interval comprising eight semitones, that is x = 8, the "harmonic distance" between the two tones, the Y, is either 8 (if the lower tone is called D, the upper is A) or 8 - 12 = -4 (D = B^{bb}) or 8 - 2 x 12 = -16 (D = C^{bb}); (2) if x = 7, the Y of this interval will be 7 - 6 = 1 (D - A) or 7 + 12 - 6 = 13 (D - $G^{\#}$) or 7 - 12 - 6 = -11 (D - A^{bb}).

A glance at the diagram proves the correctness of our formula. By taking into account the phenomenon of the octave, we can indicate the x in this way: instead of writing + as well as - we need only use the + indication. For instance, instead of writing -1 we write +11. The formula for this would be:

$$0x - n = 12x - n$$

Table 2 on p. 205 presents all the tones from y - 24 to y + 24.

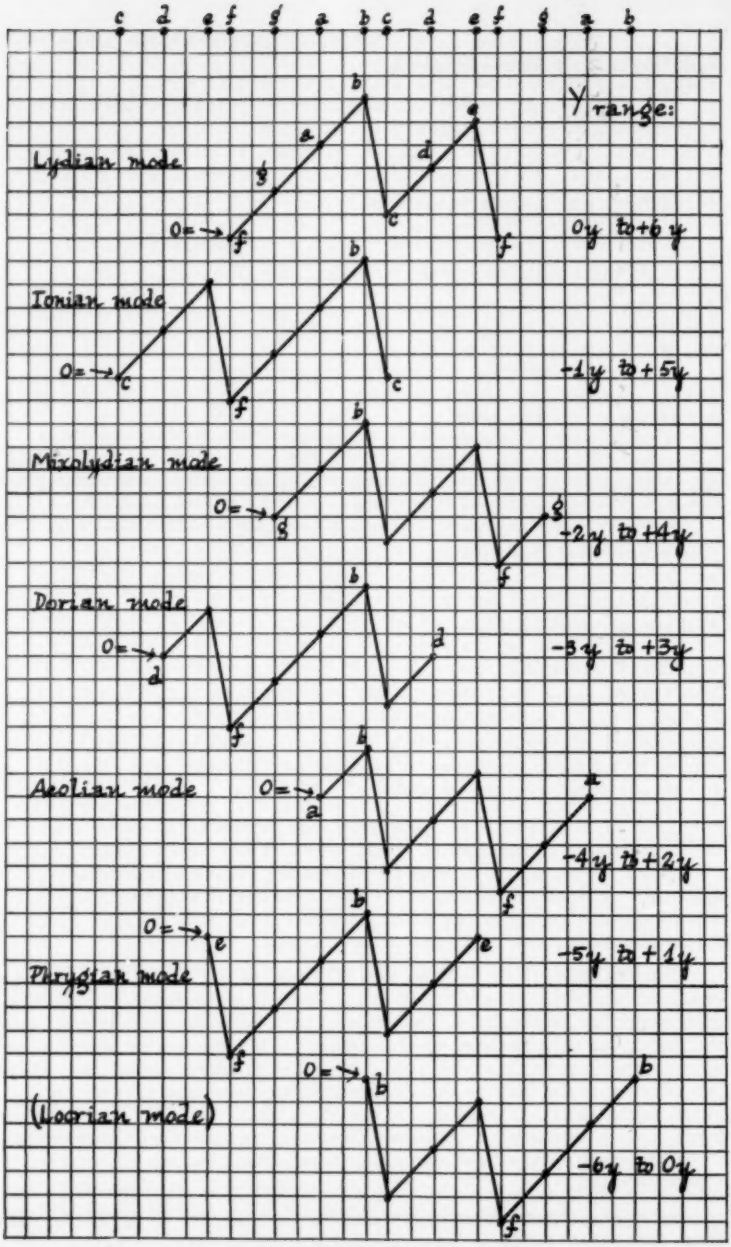
In Diagram 8 (p. 200) we see that every interval has a definite picture. There the intervals are pictured above A^{b} with their inversions below a^{b}. In Diagram 9 (p. 201) all tones between -12Y and +12Y appear in a specific position in relation to the given tonal center d = 0, so that all other tones are + and - x or y in relation to it.

By looking at these diagrams one achieves a more profound understanding of many tonal phenomena which one had only grasped empirically before. It becomes evident why the melodic ascent to d also evokes in us the feeling of "harmonic ascent" (+2y); yet the melodic ascent c to e^{b} (-3y) or to an even greater extent, c to d^{b} (-5y) awakens the feeling of harmonic descent.

In Diagram 10 (p. 203) we see that the two consonant triads are a dualistic phenomenon (contrary to the opinion of certain modern theoreticians); the major triad is expressed by a rectangular triangle, with its basis, the fifth, below, as if standing on it. Its major third points upward, and evokes a feeling of lifting the head, of elevation. Thus, the sensing of the root in the major triad is clear and unequivocal, as is its "optimistic" character. On the other hand, the basis of the minor triad, also a rectangular triangle, is above, and its third points downward, suggesting the bending of the head. The feeling of its root is also uncertain.

Let us consider what happens when we hear, let us say, an ascent from 0x(d) to 1x. The simplest possible solution (for our ear) will ex-

Diagram 12.


c d e f g a b c d e f g a b
Y range:
Lydian mode
0=→
0y to +6y
Ionian mode
0=→
-1y to +5y
Mixolydian mode
0=→
-2y to +4y
Dorian mode
0=→
-3y to +3y
Aeolian mode
0=→
-4y to +2y
Phrygian mode
0=→
-5y to +1y
(Locrian mode)
0=→
-6y to 0y

plain this as harmonic descent to -5y (e^{b}). We can strengthen this feeling by adding to this tone others from the same (minus) region, for instance, g -1y and c -2y. However, if we add to the tone +1x tones from the plus y region, for instance, b +3y and $f^{\#}$ +4y, its significance changes from top to bottom. Instead of -5y, e^{b} as in the first case, we would feel now $d^{\#}$ +7y. Here, finally, we have the solution to the problem of the enharmonic interval. We see that what seem to be the same tones in x, are opposite directions in y (see Diagram 11, p. 203). Thus, $f^{\#}$ is not merely "a kind of f" (this is partly true only in regard to x) but something very different in its harmonic (y) meaning.

It is interesting to examine the picture of the seven modes (Diagram 12, p. 208). The experience of any mode is based on the identification in the hearer of one of its tones which is felt as the root, the keynote of the mode. The psychological effect of the mode thus depends on the position of all the other tones of the mode in relation to its root; in the degree to which they are +y or -y in relation to it. I would call this experience "tonal landscape." The seven-tone row of the diatonic scale contains a definite number and form of melodic and harmonic ascents and descents. There are "hills" like b and "valleys" like f. However, the tonal landscape perceived by each listener depends upon the point from which his ear is listening, just as the landscape which our eye perceives in nature depends upon our point of view. This point is called the root, or tonal center, and is expressed by y = 0. Thus, in the Lydian mode (Diagram 12) all tones appear as ascending fifths (+y) in relation to its root — like a mountain arising before the listener and above him. Therefore, this mode is the "hardest," brightest, the most "optimistic" of them all. Of course, all these literary images are bound to confuse, since there are people who feel elated in front of a high mountain while others feel depressed. What is the truth? The truth is the mountain alone. On the other side we see how the Phrygian and Locrian modes lower themselves to a deep valley in relation to their root and therefore give a depressed, minor, soft psychological effect. The Ionian mode expresses a certain classic aesthetic ideal: starting point (c), ascent to a temporary climax (e), descent below zero (f), ascent to the real climax (b), a descent and resolution to the tonic (c). It became the most important scale in its time.

The method of notation presented here could help the teacher to explain many tonal phenomena, such as the ordering of scales according to circle of fifths, the accidentals necessary in each scale, intervals, triads, modes, enharmonic intervals, transpositions, etc. The student could, for instance, represent any tonal grouping or scale on transparent paper and then shift it to any other tone in order to see what tones and what accidentals the transposition would require. The notational method also opens up new possibilities for relating music to body movement and dance and therefore should be of interest to teachers in these fields as well.

THEORY FORUM

RE: NEW THEORIES OF FORM AND THE PROBLEM OF THEMATIC IDENTITIES

By Jan Nordmark

Among the elements of music, form has received less attention from writers on technical subjects than have harmony, melody and counterpoint. Textbooks on form are generally confined to descriptions of the so-called forms of music; that is, they are more or less valid generalizations of the structural practices of composers of different periods. The problem of quality of form, the reason for which we say that some composers possess a strong sense of form, is rarely touched upon.

There is no doubt, however, that this is an attractive and important problem, and it is not surprising that some writers should have displayed a good deal of irritation at the merely descriptive analysis of musical masterpieces, which studiously avoids passing any value-judgement on the formal aspect of the works. But it is equally true that it is a problem which contains many pitfalls for the unwary. Certain generalizations about form have a superficial plausibility which comparable theories about harmony or melody lack. Whereas we can check at once any claims to harmonic or melodic laws, form offers the imaginative theoretician unlimited scope simply because our experience of structural coherence or superlative design is more vague, less conscious, and possibly not equally strong in every musical listener. There is also more agreement as to what good melody is than what good form is.

Common to the theories that will be considered below is a belief that the analysis of musical masterpieces will, if performed according to certain principles, uncover a structure behind the seemingly unorganized mass of notes, a structure that is the true essence of musical form. This belief has various manifestations, but the more usual variant of the basic idea is that everything in a piece of great music can be demonstrated to have been derived from one basic theme or motif. This theory figures prominently in the writings of and about Schoenberg, particularly in Josef Rufer's Composition with 12 Notes, the authoritative exposition of the twelve-tone school of thought [6]. The same ideas have been expounded by Hans Keller [2], and by Rudolf Reti in his book, The Thematic Process in Music [5].

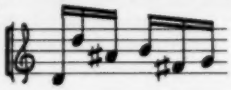
Since Reti's book is the most systematic account of these ideas published to date, I shall try to give an outline of his manner of reasoning. The problem of form in music, as Reti poses it, is: "Why do several groups of themes from different works, linked together, not bring about a composition?" His answer is: because they lack thematic unity [5, 113]. This unity is brought about not merely by a vague affinity of mood but by the formation of the themes from one musical substance. If the first and second subject of a sonata movement seem contrasted

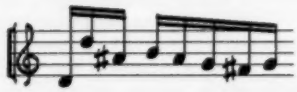
and unrelated, they are so merely on the surface; in substance they are identical [2, 5]. In a sonata or a symphony, in fact, the spirit of form is fulfilled only if the thematic shape is transformed in such a way that the new theme seems to be different from the one whence it derives [5, 57]. A composer's ability to form a theme from one which precedes it must be considered the more effective the less the two are outwardly similar. In this style, therefore, the composer must endeavor not to emphasize their identity but to conceal it [2, 58]. We find a similar thought in an article by Hans Keller: "The looser the manifest integration the stricter the demonstrable latent unification. I use this criterion as one of my critical tools for objective evaluation [2, 97]." The process by which the basic thought is varied is called thematic transformation. This process is essentially conscious, and the great composers are said to have been fully aware of its existence. Among the various categories of transformation Reti lists the well known contrapuntal devices of inversion, augmentation, etc., as well as other alterations of the musical material not generally regarded as devices, for example, change of rhythm and accent, or change of the harmonic function of a melodic shape. All these devices, and many others that were invented for the thematic style, were seldom used singly, but occurred more often in combinations of two, three, or more. A shape, for instance, which was a theme in one movement would appear in the next in its inversion and in a new tempo with accents shifted, etc. [2, 67].

At first sight this theory may appear to be no more than an extension and a systematization of the notion (only too common among music critics) that good form is assured by letting one theme give rise to all the others. On closer examination, however, we find that Reti's views on the nature of musical form differ widely, even from the views of those who believe that the first movement of Beethoven's Fifth Symphony is built on a short motif of four notes. Reti's ideas, like those of Schoenberg and his followers, are far more revolutionary. Pre-eminence in this respect must be accorded his assumption that composers of the 19th century, when interest in counterpoint, as is generally assumed, had reached a low-water mark, secretly — perhaps even unconsciously — made use of contrapuntal devices to an unprecedented extent.

When we examine the evidence upon which these hypotheses rest, it is at once apparent that no serious attempt to construct a real proof is ever made. Reti writes entirely within the presuppositions laid down by the theory and in terms of the theory interprets a selection of musical masterpieces. In these circumstances it is surprising that even his carefully chosen examples should hardly ever fit into the system. He is constantly forced to resort to additional hypotheses which have no place in the system, but which are adduced to bear out his own interpretation. As an illustration of this we quote Reti on change of tempo as a category of transformation [5, 106].

In this work [Beethoven's Sonata in G major, Op. 14/2] it must have occurred to the composer to form the theme of the second movement, the Andante, as a slow variant of the first movement's opening figure, or to be precise, of this figure's inversion. This opening figure reads:

(a)

Since as a basis for a theme this figure seems somewhat too short, the composer prolongs it by repeating two of its notes:

(b)

Omitting the first note as being identical with the second, the (transposed) inversion of this is the phrase given as (c) in the following example, which is, with a slight melodic license, the theme of the second movement (d), if the tempo is greatly slowed.

(c)

(d)

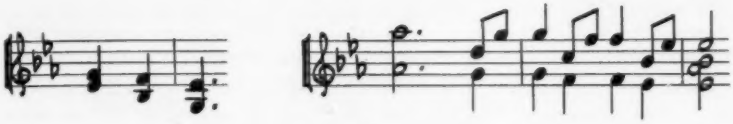
This is intended to show that change of tempo is a device used in conjunction with others to achieve structural transformation. But Reti's interpretation is valid only if we accept his basic hypotheses and if we are prepared to overlook the fact that three important differences remain, which the author tries to explain away by ad hoc hypotheses and an appeal to "melodic license."

However, Reti is convinced that he has found a proof of the connection between the two themes. In view of this it is difficult to regard his system as a model whose basic assumptions may seem adventurous, but whose value will become evident when it is applied to musical

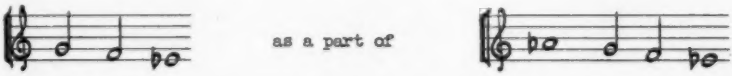
analysis. For even granting these assumptions, the agreement between theory and fact is never close, and Reti constantly must resort to rather peculiar devices to explain away inconsistencies. One of these is the "singling out" or "bringing into relief" of some among a number of notes in order to prove the connections.

But to Reti the analogies are always "striking" and "unquestionable." He seems to believe that he has found a truth which, being self-evident, does not require substantiation. His discussion of the "cutting of thematic parts," another category of transformation, is illuminating in this connection (p. 88):

> In Beethoven's Sonata, Op.81a, "Les Adieux," the opening of the Adagio-Introduction, the famous "Lebewohl," and the beginning of the first Allegro theme read as follows:



> Is there any relation between the two? True, the notes G, F, E-flat, of the first shape conform with the melodic course of the last part of the second group. Yet were the two shapes played to us independently, we would certainly not consider them related at all. Apart from all differences in character and phrasing we would, even as a matter of principle, refuse to accept the melodic idea expressed by:



> The latter appears to us, according to all musicianly concepts to which we are accustomed, as a musical entity of its own, from which no note can be "cut off."
>
> Yet Beethoven proves that this is not a cogent conclusion. As he chooses the two shapes as the alternating thematic utterances of this movement, we must, according to all structural principles as manifested in all his works, take it for granted that the one is a "derivative" of the other."

That is, we must discard all unfavourable evidence because the thesis has already been proved. We often come across similar thoughts in Reti, but the argument is particularly questionable in this case, since

on several occasions earlier in his book he has removed a note or two in places where otherwise Beethoven's adherence to the thematic technique would seem doubtful — a circular procedure characteristic of much of Reti's reasoning.

But the above quotation is illuminating in another way, for Reti unwittingly points to the fatal weakness of his and similar theories, namely, that we do not experience the two themes as related at all. This also applies to the last two melodic patterns in the passage quoted above. With reference to these successions of notes, although in a different context, the psychologist C. C. Pratt writes: "It is hardly likely that anyone hearing the last three notes of God Save the Queen will be brought up with a start at the end by noting the resemblance to the first measure of Three Blind Mice, or vice versa [4]."

Reti's error is his confusion of psychological affinity with what I would like to call formal affinity. As these examples show, not even the fact that a group of notes and the rhythm are common to two melodic figures is enough to make us notice any resemblance between the figures when they occur in different contexts. They may have a certain formal resemblance, but psychologically they are completely unrelated.

Reti, however, is concerned only with formal affinity, and even this is seldom remarkable. It is quite possible, in fact, that he was led to formulate his theory of form by a false analogy with logical deductive systems. He seems to regard the categories of transformation as analogous to logical rules of deduction or modes of thought. This would explain his belief that two themes which seem unrelated may in reality be identical. The theorems of a deductive system may, in a sense, be said to express nothing that is not already contained in the axioms and rules of deduction of the system, although they may have the appearance of being unrelated. If one regards the categories of transformation as analogous to rules of deduction, one might be led to assume that identity is preserved regardless of the number of transformations which the original musical material undergoes.

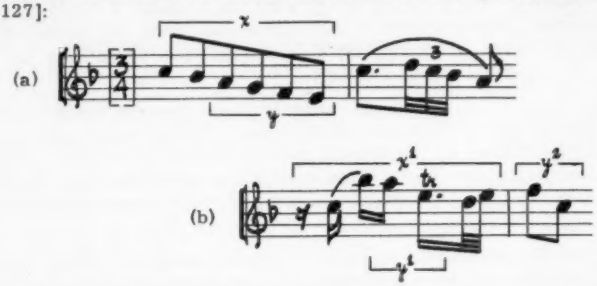
Transformation, however, is not the same thing as logical deduction. In a transformation some properties are changed and others remain unchanged, or "invariant." It is the properties which two things have in common that make us perceive similarity, affinity. Consequently, we are less and less likely to notice any affinity the greater the number of transformations required to proceed from one theme to another, because there will be correspondingly fewer properties in common.

A transformation can also have a very great effect or practically none at all. For example, slight change of tempo will be of no importance, whereas a change of rhythm may alter character drastically. Or the transposition of a melody from one register to another will be of no consequence, while the fact that one theme is the inversion of the other may escape us. According to Reti, there is no change in either case, since inversion is a literal repetition of shapes, and stands at one end of the gamut between full identity and non-relationship [5, 239].

But again, it seems obvious that the extent of the change will determine whether or not we experience similarity. This is in agree-

ment with everything we know about recognition from psychology. Reti's conception of degree of affinity is not psychological, but formal: certain transformations involve no real change, and the number and extent of the transformations will not affect the essence of the theme. As I have tried to show, this is primarily a logical mistake. We may note in passing that Reti's views on the workings of the human mind are just as revolutionary, to say the least, as his ideas about musical form.

The evidence which Reti presents is, as I have said, extremely unsatisfactory even if one accepts his basic assumptions. Naturally the analytical results will seem more convincing in proportion to the number of permissible rules of transformation, and the analyst's task will be correspondingly easier.

The Schoenberg school has added retrograde inversion and octave transposition to the list, which makes the following derivation possible [5, 127]:

Now, a seventh is regarded as equivalent to a second because the seventh is one whole-tone from the octave of the lower note of the interval, and two tones in octave relationship have an identical quality, which enables us to recognize a C in any register. But one cannot disregard the fact that two tones an octave apart differ with respect to pitch. Thus, to regard a second and a seventh as completely identical is a logical mistake of the same kind as the one we met earlier. Needless to say, they are not experienced as similar at all.

With such analytical tools at their disposal and with the emphasis on short motifs rather than full themes, it is hardly surprising that the Schoenberg school should be able to demonstrate closer agreement between music and theory, however superficially; but the falseness of the basic assumptions and the arbitrariness of the method are readily apparent.

Thus, in common with Reti, they try to explain entire compositions from a series of intervals, or even from one interval, disregarding the fact that a motif or a melody has a rhythmic aspect which cannot be separated from the melodic one. One interval certainly can constitute a theme, provided that it is used in a characteristic way. An example of this is Beethoven's Piano Sonata, Op. 2/2, where a descending fourth is the main theme. But it would be quite meaningless to hunt for hidden fourths in places where this situation is not at hand,

because no association with the original motif is ever formed, nor was it intended to be formed.

The reason for this is that the mind concentrates, consciously or unconsciously, on the unusual aspects of the musical material and pays no particular attention to what is only a basic constituent of music. For a single interval like a fourth to have structural importance, it must be used in a characteristic way. Any transformation that destroys the characteristic feature will also render impossible any feeling of resemblance.

It is only natural, therefore, that the analysis of a Mozart string quartet purportedly founded on the motif of a fourth should be able to list many examples of the use of a fourth, "filled up scalewise" or not. Nor is it surprising when Mr. Rufer ends his analysis of the first movement of Beethoven's Piano Sonata, Op. 10/1, with the statement that the further development of the movement is dominated mainly by motif "b" [6, 46]. Since motif "b" is a falling second it would be difficult to find any music where it is not present, with the possible exception of the music of Central New Guinea, whose inhabitants are reported to sing exclusively in fourths.

In fact, no effort has been made to guard against the possibility that the derivations of thematic analysis could not be made equally well starting with a theme in a different work, chosen at random. Indeed, since no two analysts ever arrive even at an approximately identical result in their examination of the same work, this is more than a possibility.

And as Eric Blom has pointed out, it still has to be shown that the analytical method will give evidence of real differences between good, bad, or indifferent works. So far, it is only Haydn's compositions and those of Liszt — because "they are an uninterrupted series of all too obvious thematic connections" — that have failed to satisfy Reti's aesthetic norms.

Let us now consider what historical evidence can be brought to bear on the problem. The composers themselves have been silent on this point, which is particularly strange if one regards the thematic process as conscious. Since the thematic technique, according to Reti, was never handled in a more intense, concentrated, and conscious manner than in Beethoven's music, and since we happen to know from his sketchbooks more about his way of composing than about that of any other composer, we are provided with a test for all unitary theories of form.

There is abundant evidence in the sketchbooks to show that the thematic process is but a figment of Reti's imagination. Nottebohm, who published many of the sketches, has disclosed that Beethoven transferred the original finale of the Violin Sonata in A major, Op. 30, to the Kreutzer Sonata, partly because it was, in the composer's own words, too brilliant, and partly because he had no time to write a new finale for the Kreutzer Sonata, a public performance already having been arranged. The Alla danza tedesca movement of the B-flat Quartet, Op. 130, was originally intended for the A-minor Quartet, Op. 132, and even worked out in A major. For its last movement the latter

quartet appropriated, almost without a change, the theme originally planned to be the main theme of the instrumental finale of the Ninth Symphony. Since Reti has analyzed the B-flat Quartet at great length, has found therein "a proof of almost mathematical conclusiveness" [5, 234] of his thesis, and has devoted two pages to show that the Danza tedesca is derived from the basic theme of the Quartet, grave doubts are cast on the methods of the analytical school.

The picture of Beethoven's manner of composing that emerges from the sketchbooks must be shocking to the believers in the thematic process. Very often he jotted down scraps of melodies as they came to mind and, if he had no immediate use for them, he allowed them to remain until he could fit them into some compositional scheme together with other ideas, which may have been arrived at independently. The reasons for his choice can be described best in terms of balance, proportion, affinity, or contrast of mood or character, etc.

But in this way no real unity can be achieved, it may be objected. The objection is not valid, however, for Reti and the Schoenberg school use the word unity in two different senses, one very general and one highly specific. In the first, the term indicates that an art work is an organic whole, that "the sum is more than the parts." Second, unity means that one basic thought provides material for an entire work. When the music fails to conform to the theory these meanings are equated. Thus, Rufer writes: "The whole collection of themes in a work, though apparently independent of one another, can be traced back to a single basic idea.... This corresponds to the thesis that a work of art is a unity, the unity existing even where it cannot be exactly demonstrated [6, 29]."

The thematic theories of form, which tend to oversimplify complex problems without explaining anything, recall many instances of the reductionism typical of so much Central European science. This is exemplified by Goropius, a scholar of the 16th century, who asserted that Adam spoke a dialect of German, and that all other languages derived from that Teutonic prototype. In seeking the "hidden relations" and the "secret meaning" in music the authors of these theories show that speculative mysticism is more important for today's music than is commonly realized.

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RE: THE PRINCETON SEMINAR IN ADVANCED MUSICAL STUDIES

By David Cohen

What is one really talking about when one discusses music? In the first meeting of the more than thirty composers and other musicians who attended the Princeton Seminar in Advanced Musical Studies (August 13 - September 3, 1960), Roger Sessions raised this question. Although not intended as a keynote address, his lecture sounded a theme which was developed in diverse ways by almost all the other lecturers.

On the surface the various series of lectures and discussions did not deal with general theoretical topics. Roger Sessions and Karl-Birger Blomdahl built their lectures around presentations of their own music, and Elliott Carter devoted one of his six lectures to a discussion of his recent compositions. (The other five reviewed the practical problems of the American composer.) Earl Kim analyzed in detail the Schoenberg String Trio, and Milton Babbitt provided prolegomena to the composition of electronic music.

The material introduced in the lecture-and-discussion periods became points of departure for those attending the Seminar. Outside the framework of the scheduled events, they attempted to reconcile the divergent views and raised for themselves more fundamental questions. Mr. Sessions' statement that scientific talk about music is not relevant represents one position; the severe technical demands of electronic music described by Mr. Babbitt represent another. These two positions must be brought into perspective if one is to have a coherent view of the music of today.

Mr. Sessions' position is presented with great precision in his book, The Musical Experience, and does not lend itself to simple or unqualified summary. It seems fair to say, however, that he places a limit beyond which analysis cannot go in attempting to explain music. The Seminar as a whole revealed not so much an opposition to this attitude as a lack of agreement concerning where to place the limit. This seemed to reflect a basic disagreement over the purpose of analysis.

A composer's discussion of his own music may not be an accurate indication of his attitude toward analysis in general, because of the element of personal involvement. One can only report that the three composers who discussed their music at the Seminar shared a tendency to avoid detailed technical discussions, and especially to consider the working procedures as irrelevant once a particular composition is completed. Mr. Sessions stressed the relationship of phrase structure to rhythmic movement in his composition; Mr. Blomdahl spoke of his attempts to achieve the "aural vision" suggested by the texts he set; and Mr. Carter described the manner in which he strove to give individual characterization to each instrument in the Second String Quartet. These are merely indications of some topics which were discussed. They are given to suggest the discrepancy between what a composer is willing to say about his music and what an analyst seeks to discover.

It is easy to find analysis which does no more than attempt to reconstruct the composer's working procedure from the finished product. Most row analyses of serial compositions are of this type. Mr. Kim avoided this approach in his analysis of Schoenberg's String Trio. He sought to demonstrate that the wide diversity of material in this work is in fact derived from the opening measures and that the degree of subtlety in the treatment of thematic transformation is nearly unique among Schoenberg's works. Edward Cone, in a special lecture, presented a new approach toward understanding the fragmentation of texturally related sections in Stravinsky's music. Neither of these analyses completely escaped the kind of "intentional" fallacy which assumes that the purpose of analysis is to describe how the composer intends the work to be heard, and that this intention can be discovered by examining the score and related sources (remarks of the composer, knowledge of his style derived from other works, etc.).

Electronic music raises the question of analysis in quite another way. At the present stage of development, discussion of electronic music may be premature, since most available examples only serve to give the medium a bad name. Mr. Babbitt's presentation stopped short of both the compositional and aesthetic levels and concentrated instead upon basic problems in the psycho-acoustical realm. This approach had the virtues of giving a detailed coverage to technical difficulties which are widely misunderstood and of allowing the participants to work out their own conclusions in an area which is, at the moment, highly problematical.

Composers who have worked with electronic music, employing the Electronic Synthesizer or more conventional means (tone-generators, filter systems, mixing panels and tape-splicing), have discovered wide gaps in our knowledge of the relationship between acoustical and electronic specifications for a sequence of tones and their auditory perception. Consideration of the psychological concept of "equal loudness" will illustrate the nature of the difficulties encountered. One should be able to achieve this effect by specifying "equal intensity." But different pitches do not sound equal; the effect of loudness varies also with changes of timbre and mode of attack. It further appears that two tones which would be considered equally loud if sounded successively are no longer recognized as such when separated by a louder tone. Some of the many problems still requiring investigation are the extent of recognition of durational relationships, the limits of perception in regard to frequency of attack, the conditions under which tones of close frequency can be combined without producing beats, the treatment of transients in non-instantaneous attacks and, under the general heading of timbre, effective methods of avoiding the steady-state tone.

Mr. Babbitt's lectures stimulated speculation far beyond the material he covered. Many felt that the technical complexities are such that few composers will master them. The electronic technician may well achieve the status of performer who translates the composer's indications into acoustical equivalents. Nonetheless, there were those who felt, as I do, that the advent of electronic music must result in a more rigorous definition of the relationship of technique to compositional results.

There is an element of chance in present electronic music because of lack of experience with the medium. The composer does not know what the results of a given procedure will sound like until he has tried it. This kind of chance has different aesthetic implications than the "chance" of the musical dadaists or the element of chance involved in the controlled flexibility of serious use of improvisation. Once the technical problems are understood — and the Electronic Synthesizer offers an excellent tool for investigation — the question of "the intent of the composer" will be meaningless. Few things are more precise than an electronic tape or the specifications necessary to produce it. The question at the moment is how to comprehend the enormous possibilities and learn to get precisely what we want.

In order to meet the challenge of electronic music, a more exacting theory of analysis will be necessary. The precision demanded by this new medium may well assist in shaping such a theory. Until we better understand the tenuous line of relevancy between technique and results, both the full realization of the new medium and the development of traditional media are sorely hindered.

Those who attended the Princeton Seminar to find answers were for the most part disappointed. But there were many who felt that its real success lay in the significant questions it posed.

RE: PSEUDO-SCIENCE IN MUSIC

By John Backus

Joseph Schillinger (1895-1943) was a well-known teacher of musical composition in New York City. He included among his students a number of established musicians, the most famous being George Gershwin, who, it is claimed, wrote Porgy and Bess under Schillinger's tutelage.[1] His teaching career became important enough to warrant mention in Collier's Encyclopedia, Baker's Biographical Dictionary of Musicians, and other reference works.

The results of these years of teaching are embodied in two books. The first of these is The Schillinger System of Musical Composition (Copyrighted 1946 by Carl Fischer, Inc., New York. Subsequent excerpts quoted with their permission.) The second book is entitled The Mathematical Basis of the Arts (published in 1948 by the Philosophical Library). The first is a compilation of the material Schillinger used in his teaching, the second includes the results of his investigations in the fields of art and design as well as music.

These two works are quite formidable. Composition runs to 1690 pages in two large volumes. Each volume is divided into sections, beginning with Book I, "Theory of Rhythm," in Vol. I and concluding with Book XII, "Theory of Orchestration," in Vol. II. In addition to a large number of musical examples, the work contains quantities of mathematical symbols, algebraic expressions, tables, and graphs. Mathematical Basis uses a more concise 696 pages; it has an even greater density of mathematical language, and contains in addition a considerable number of complicated geometric patterns. Both works give the appearance of requiring years of study for their mastery.

The aims of these works are awe-inspiring. Composition opens with a preface, "Overture to the Schillinger System," by Henry Cowell, who says: "The idea behind the Schillinger System is simple and inevitable; it undertakes the application of mathematical logic to all the materials of music and to their functions, so that the student may know the unifying principles behind these functions, may grasp the method of analyzing and synthesizing any musical materials that he may find anywhere or may discover for himself, and may perceive how to develop new materials as he feels the need for them." In the subsequent laudatory Introduction by Arnold Shaw and Lyle Dowling, Composition is described more concisely with the broader statement: "The Schillinger System is a synthesis of musical theory and the most recent discoveries of modern physics, psychology, and mathematics. Historically, it represents the first successful effort to classify scientifically the resources of our musical system." Finally, Schillinger himself says of Mathematical Basis: "Its goal is to disclose the mechanism of creatorship as it manifests itself in nature and in the arts."

1. For an evaluation of this claim, see David Ewin's biography of Gershwin, A Journey to Greatness (Henry Holt, N.Y.), p.243 ff.

These are substantial goals indeed, and one might well wonder with some anxiety to what extent Schillinger has realized them. If the composition of music can be reduced to the application of mathematical logic, it is high time we realized the fact and incorporated it into our musical thinking. Two possible consequences come to mind: on the one hand, so much new material would be available to composers that music would grow and blossom rapidly in fresh directions, dwarfing in new glory all that has been done before; on the other hand, with composing reduced to mathematical principles, practically everyone could be his own composer, and music might smother in its own surfeit. Either of these consequences seems important enough to warrant an evaluation of Schillinger's work.

A search of the professional journals unfortunately does not help us to arrive at such an evaluation. Reviews of Composition upon its publication cover quite a range of opinion. There is praise of the work as a great advance in revitalizing musical theory and placing it on a scientific foundation [1;2], complaints about its mathematical approach [3;4], and assertions that the whole thing is worthless [5;6;7]. In a very conscientious and careful review [8] J. Murray Barbour concludes that the claims made by Shaw and Dowling regarding the value of the work are not substantiated by a critical examination, and that Schillinger is not as competent an authority in all fields of music as he pretends to be.

Aside from the reviews, there is very little mention of Schillinger in the literature, and that which exists has generally a little of the flavor of patent medicine testimonials.[2] Nowhere is there an evaluation of the scientific and mathematical foundations of Schillinger's system to help the non-mathematical musician assess its importance. Musicians in general seem rather unwilling to discuss the subject; not being mathematicians and scientists, they are understandably reluctant to criticize a system which claims to have a foundation in mathematics and science. Even if its musical results do not amount to much at present, there is the possibility that basically it is sound and will ultimately realize the claims made for it by its spokesmen.

Let us therefore examine as much of Schillinger's work as may be necessary to evaluate its soundness in the areas of science and mathematics.

Composition begins with Book I, "Theory of Rhythm." An editorial preface states that this theory is basic to the entire work, so we shall examine it in detail.

Chapter I begins with a discussion of graphs, illustrated by the representation of a simple musical sound such as the sound wave from a tuning fork (the curve mathematicians call a sine wave). In the discussion of this curve on p. 2, we find two errors: the word phase is used incorrectly, and the term amplitude is taken to be synonymous with intensity. Physically, intensity is proportional to the square of the amplitude of a simple sound wave, so the two words are not synonymous. However, we find on reading further that Schillinger actually

2. See, for example, The Musical Quarterly, Vol. 33 (1947):102.

wishes to define what he calls a "rhythm graph" which looks like this:

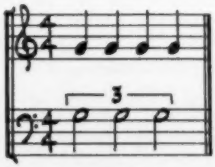
in which horizontal distances represent time and vertical lines represent the instant something happens, such as the sounding of a note. This graph has so little in common with the sine wave discussed earlier that the material of the first two pages of the book might just as well have been omitted.

Chapter 2, "Interference of Periodicities," discusses the "generation of resultant rhythmic groups as produced by the interference of two synchronized monomial periodicities." This highbrow language is apparently meant to add dignity to a very elementary process. This process Schillinger calls finding the "resultant" of two numbers or "generators," and is expressed as $r_{a \div b}$.

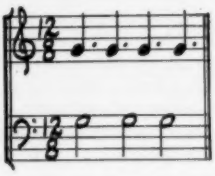
In trying to understand Schillinger's work, we are constantly beset by two difficulties. One is his use of familiar terms in other than the usual meanings; the use of the division sign ÷ as above is only the first of numerous examples. Of course, one might argue that using familiar signs with new meanings could be preferable to inventing new ones, in that the material would have a more familiar and less frightening appearance than if all new symbols were used.

The second and much greater difficulty is the language and literary style. When, in addition to familiar symbols, familiar words are used in new and undefined meanings, we really get into trouble. On p. 6, for example, we read: "... even the most noted composers of today do not seem to know that to express a bar before a non-uniform group is offered is to represent the scheme of uniformity with respect to the periodicity of accents." This must be an important statement, since the italics are Schillinger's, but a great deal of study has failed to squeeze a drop of meaning out of it. Unless we know what Schillinger means by "express a bar," "scheme of uniformity," etc., we are helpless. Perhaps Schillinger knew what this sentence means; it is doubtful if anyone else does, at least from reading the material.

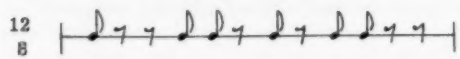
The unfortunate language makes it impossible to determine from the description alone the nature of the process of finding the "resultant $r_{a \div b}$" of the "binary synchronization" of two "generators" a and b. However, by studying the diagrams given as illustrations we can determine what the process is. We find that the "resultant" of say 4 and 3 is the rhythmic pattern obtained when we play 4 notes against 3. For example, to play the following,



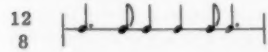
we could assume it to be written in $\frac{12}{8}$ time (4 x 3 = 12) and rewrite the passage like this,



which gives the rhythmic pattern,

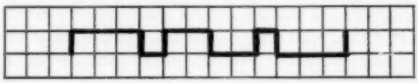


or, omitting the rests,



To describe the process somewhat differently: to find the "resultant" of 4 and 3, assume a measure of 4 x 3 = 12 beats, such as eighth notes; put a note on the first beat; put a note after every 4th beat (5th and 9th beats); then put a note after every 3rd beat (4th, 7th, and 10th beats). The result is the eighth note pattern above.

Schillinger uses his "rhythm graphs" to picture these patterns. The last pattern above (without rests) would look like the following,



where time is plotted horizontally, as mentioned before, and the small squares represent eighth notes. He also expresses them numerically, getting for the pattern

$$3 + 1 + 2 + 2 + 1 + 3$$

where the digits represent the number of eighths per note.

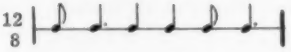
Neither of these representations is necessary, as the process described above may be used to find "resultants" directly in terms of musical notes. Schillinger, however, is very fond of both methods of representation. He is also very fond of working out great numbers of numerical examples by substituting, ad infinitum, into simple algebraic expressions, rather than by showing a few examples and letting the reader of ordinary intelligence go on by himself. In Appendix A of Mathematical Basis there are 54 pages of "resultants" shown numerically and graphically. Although these are impressive enough at first

glance, the contents are little more than extensive doodling, and can be called mathematical only by courtesy.

Whatever their mathematical content, the important question concerning "resultants" is their usefulness. Schillinger makes broad claims. For example, on p. 6 he writes: "Through the procedure described above, one may obtain all the rhythmic patterns of the past, present, and future." And on p. 10: "All rhythmic patterns in music are either complete or incomplete resultants." These statements are preposterous. Take any "resultant," such as the one obtained above, and interchange any two unequal numbers; the result will be a rhythmic pattern that cannot be obtained by Schillinger's procedure, as can be easily proven.[3] The pattern (to use Schillinger's notation)

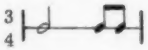
1 + 3 + 2 + 2 + 1 + 3

(or in notes) 12/8

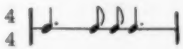


obtained by interchanging the first two digits or notes of the 4 to 3 pattern obtained above is not a "resultant." To go even further, any number of simple rhythmic figures may be devised which are not "resultants" or parts of "resultants." All of the following are in this category:

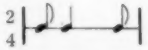
3/4



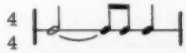
4/4



2/4



4/4



We conclude, therefore, that Schillinger's "resultants" do not give all possible rhythms, as claimed; in fact, the number obtainable by his method is quite small. However, there is another and more important claim made for them, which is not explicitly stated in the first chapter and which we will discuss below.

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3. In any "resultant" obtained by the method described, it may be easily seen that each number in the "resultant" is either the "minor generator" or else one of a pair of adjacent numbers whose sum equals the "minor generator." For example, in the 4 to 3 "resultant" above,

3 + (1 + 2) + (2 + 1) + 3

the bracketed pairs add up to the "minor generator" 3. Therefore, any pattern not having this property cannot be a "resultant."

Let us proceed. Chapter 3 is unimportant. Chapter 4 describes a method of obtaining "resultants with fractioning." Again the verbal description of the process is impossible to follow; analysis of the examples given shows a process even more arbitrary than the previous method of obtaining "resultants." Describing this process would serve no useful purpose.

Chapter 5 discusses rhythmic groups formed by combinations of both kinds of "resultants." Here we find a statement which is important in shedding some light on Schillinger's point of view; after a discussion of Beethoven's crudities in composition, he states: "as the resultants which have identical generators have a great deal in common, such performance gives the utmost esthetic satisfaction (p. 21)." That is, if we add the "resultant" of 4 and 3 to the "resultant with fractioning" of 4 and 3, we get something aesthetically superior by virtue of having the numbers 4 and 3 represented in both parts.

This idea is carried further in Chapter 6, "Utilization of Three or More Generators." Here he states: "It happens that all generators pertaining to one family of rhythm belong to the same series of number values (p. 24)." (It is not clear what is meant by a "family of rhythm.") An editorial footnote here states that this crucial sentence will be explained fully in Mathematical Basis; unfortunately a search of this volume uncovers no such explanation. It is clear, however, that considerable aesthetic importance is attached to certain sequences of numbers. Further down on the page Schillinger says: "I have found in the field of music that each style (or family) of rhythm evolves through the series of such types ["summation series"]. Here are all the series that are useful for musical purposes:

I. 1, 2, 3, 5, 8, 13 . . .
II. 1, 3, 4, 7, 11, 18 . . .
III. 1, 4, 5, 9, 14, 23 . . .

As previously mentioned, all rhythmic groups (or patterns) of one style are the resultants of the generators of the same series."

This is a sweeping statement and one which makes quite clear Schillinger's basic point of view. The statement itself is somewhat unsatisfactory; we should perhaps like to have a better idea of what constitutes a family or style of rhythm; having this, we should then like to see a convincing number of examples demonstrating clearly the connection of these families with the numerical sequences cited (the word series is incorrectly used). However, we have only Schillinger's bold statement, "I have found . . . ," with no evidence whatever that he has found anything. His point of view is clear enough, however; if we start, for example, with the "summation" sequence 1, 2, 3, 5, 8 . . . (each term after the second being the sum of the two preceding), juggle numbers out of it by finding "resultants" as above, and turn these numbers into music, we will have something aesthetically superior by virtue of being based on this series.

What Schillinger begins to reveal is not a mathematical or scientific point of view at all; instead, it is pure numerology.

To proceed, omitting unimportant material, Chapter 8, "Coordination of Time Structures," has at first glance quite a straightforward structure. The problem to be discussed is stated as "the distribution of a duration group through instrumental and attack groups." There follows a list of the definitions of the terms to be used, then some pages of mathematical equations using these terms together with musical examples. Examining this material in more detail in order to try to make sense of it is a most frustrating experience. Looking at the list of terms defined under "Notation" (p. 35), we see the following:

(a) pli number of places in the instrumental-group
(b) pla number of places in the attack-group
(c) a_a number of attacks in the attack-group

An "attack-group" is apparently a sequence of notes, but what is the difference between "attacks" and "places"? Next is:

(d) a_T number of attacks in the duration-group

The term "duration group" has not previously been defined, nor is it here. At the back of Vol. II is a glossary compiled by the editors; if we turn to it for help, we find "duration-group" defined as "a group of one or more durations in time," which is very little help. Then we see:

(e) PL the final number of places

Places of what? We turn to the glossary; "places" is not listed. There follows:

(f) A the synchronized attack group (the number of attacks synchronized with the number of places.

Here is more trouble; it is not clear whether we are to use "places" from (a), (b), or (e) above. Worse still, how do we "synchronize" these quantities? This word apparently has a different meaning in Chapter 8 than it did in Chapter 2. The glossary defines it as "making two series occupy the same time," which means nothing. There are more terms defined, but we need not waste time on them; the whole list is hopelessly obscure.

If we now look at the mathematical symbolism on the following pages for help, we get none. The terms appear in equations as obscure as the definitions; symbols, letters, numbers, and bars of musical notes are mixed up in a hodge-podge that makes no sense whatever as mathematics. Whatever ideas Schillinger is trying to express here would be much more easily understood if the "mathematical" trappings were removed. The whole chapter is a fine example of what we might term pseudo-mathematics. It is not surprising to find pseudo-mathematics in a theory whose basis is numerology.

Chapter 9, with the impressive title, "Homogeneous Simultaneity and Continuity (Variations)" begins with an erroneous definition of circular permutations. There follows in this and the subsequent two chapters a good illustration of Schillinger's penchant for working out

examples in profusion; instead of simply stating that the letters a b c d may be permuted in 24 ways, for example, he writes out all 24 permutations (p. 56).

Chapter 12 begins with a discussion of "series of factorial-fractional continuity," each "series" having a "determinant $\frac{1}{1}$." The term determinant is not used here in its accepted mathematical meaning, and there is no such thing in mathematics as "factorial-fractional continuity." A discussion of the application of these "series" to music ensues; this material would be very important to musical analysis if it had any verifiable basis, but again not a single example or illustration is given to lend credence to the assertions made. (There is one minor exception, a reference to the literature on p. 72, the first such, incidentally, to appear in the book.)

A typical Schillinger assertion appears on p. 74: "The law of distributive powers is a common esthetic law of proportionate distribution of harmonic contrasts." This sounds important, so we would like to know what it means. The subsequent material discusses "distributive powers" using numbers and graphs, and this time we are able to discover what the term signifies. It is simple enough: if, for example, we multiply out $(3 + 1) \times (3 + 1)$ we get $9 + 3 + 3 + 1$, applying the usual algebraic rules. This result is what Schillinger calls the "distributive square of a binomial." We can of course use longer strings of numbers, change their order in arbitrary ways, and raise to higher powers. Schillinger is very fond of this process; 140 pages of Mathematical Basis are filled with such numerical trivia. The word "synchronize" appears again, in a still different and undefined meaning. There is no evidence presented to show that these "distributive powers" have anything at all to do with any aesthetic law; we are still in the realm of numerology.

Chapter 13, continuing the discussion, makes the statement: "All the consecutive interference-groups generated by one determinant constitute the evolution of all rhythmic patterns in the corresponding family (style)." (Emphases Schillinger's) We can recognize this now as another assertion with no basis but numerology.

The concluding chapter of the "Theory of Rhythm" begins with the statement: "The only constant velocity known in the physical world is that of light." This is nonsense; the velocity of light is not constant, but depends on the medium in which the light is traveling. Schillinger obviously has heard somewhere the postulate of the special theory of relativity, that light has the same velocity for all observers regardless of their state of relative motion, and has misinterpreted it. The second paragraph begins with the sentence: "The ratios of acceleration through gravity grow rapidly." The acceleration of gravity is a constant at any given place, varying only slightly over the earth's surface, and cannot grow at all; the expression "ratios of acceleration" is meaningless.

Having considered "Theory of Rhythm" in some detail, we can form several conclusions: (a) there is practically nothing in it that can be dignified by the name mathematics; (b) it contains a number of errors and much misused mathematical terminology; (c) terms important to the discussion are frequently defined incomprehensibly or

not at all; and (d) completely unverified assertions are made regarding the aesthetic value of the numerical manipulation which fills the book. We now have a fair idea of what to expect in subsequent chapters, but let us look a little further before passing final judgment.

We next encounter Book II, "Theory of Pitch Scales." In Chapter 2 of this book we find that any group of from one to eleven consecutive notes within an octave taken in an upward direction is one of the "First Group of Pitch-Scales." Picking out one such scale, its notes may be permuted in various ways, giving other groups of notes; these groups may then be permuted, etc., etc. Schillinger fills the chapter with lengthy examples of these permutations.

In Chapter 3, "Evolution of Pitch-Scale Styles," we find scales of few notes used to generate scales of more notes by "interference." What the process is this time is not explained; it is not the "interference of monomial periodicities" we discussed before. Whatever the process may be, it is supposed to produce families of scales all having the same "style."

The "Second Group of Pitch-Scales," (Chapter 5) is derived from the first by a process of "expansion." For once, the process used is clearly explained; it is also quite arbitrary. The assertion is made that by "expanding" music by Mozart we can produce music in the style of Ravel.

We are introduced to the "Third Group of Pitch-Scales" by Chapter 6, which tries to connect the musical styles of various composers to the various roots of the number 2. Some illustrative musical examples here would be of great value, since considerable study has failed to derive any meaning from the discussion. We read, for example (p. 146), that Wagner used harmonic forms built on $\sqrt[4]{2}$, while Liszt used those based on $\sqrt[3]{2}$. A musician might assume that this statement is clear to a mathematician, and conversely; to one acquainted with both fields, however, it makes no sense at all.

In the subsequent Chapter 7 we find scales with 2, 3, 4, 6, and 12 "tonics." These arise from the circumstance that there are 12 notes in the octave, and 12 is divisible by each of the above numbers. For example, dividing the octave into three parts, we get the notes C, E, A^b, the frequencies of these notes in the tempered scale being in the ratio $1:2^{\frac{4}{12}}:2^{\frac{8}{12}}$. Interpolating additional notes between these, we get "3-tonic" scales. By picking out notes with frequency-ratios given by other fractional powers of 2, we get "2-tonic scales," "4-tonic scales," and even "12-tonic scales." When every note in the chromatic scale is a "tonic," what do we do for dominants? The term "tonic" has such a well-established meaning in music that to use it in any other sense is indefensible. True to form, Schillinger writes out in detail all the possible "N-tonic" scales starting on C.

Using certain other fractional powers of 2, Schillinger gets the "Fourth Group of Pitch Scales." One of these extends over a range of eleven octaves; its usefulness would seem to be limited, since the normal hearing range is less than ten octaves.

The "Theory of Pitch Scales" thus turns out to be no theory at

all, but a collection of arbitrary numerical rules for getting sequences of notes which are called "scales," and which are supposed to have aesthetic value from having such a numerological basis. We could assert with equal validity the usefulness of scales selected by throwing dice.

Book III, "Variations of Music by Means of Geometrical Projection," need not detain us long. Schillinger announces the discovery of "geometrical inversions" — the processes of inverting a melody, playing it backwards, and inverting it backwards — as though they were something new instead of devices known long before Bach. Introducing some rearrangements of Bach's Two-Part Invention No. 8, Schillinger states (p. 193): "By comparing the music of J. S. Bach with the following illustrations, the full range of what he could have done with the method of geometrical inversions becomes clear." Again, on the next page: "In another case, that of Fugue No. 8 from Bach's Well-Tempered Clavichord, V. 1, if we compare the first 12 bars of the original with the version evolved from this same theme by means of geometrical inversion, we cannot fail to see the esthetic advantage of this method of composition over the more casual one derived partly from dogmatic and partly from intuitive channels." Again, on p. 202: "This device is superior to the ingenuity of any composer using an intuitive method . . . ." The effrontery of these statements is staggering; but let us go on.

Book IV discusses "Theory of Melody." (By this time we are a little suspicious of the use of the word theory as a description of Schillinger's assertions.) We find in Chapter 3 the "primary axis of melody" defined as a "pitch-time maximum"; that is, the primary axis of a melody is the note which has the longest total duration when all its occurrences are added. With this concept Schillinger shows (p. 250) that the opening 8-bar melody of the second movement of Beethoven's Piano Sonata, Op. 13, is not in A^b major after all, but starts out in the Mixolydian mode and then modulates to the Dorian mode. The next paragraph shows how the theme of the third movement can be improved. Musicians may judge for themselves the validity of these assertions; there is no basis in either physics or mathematics for a "primary axis of melody."

There follow some 75 pages of graphs whose function is completely obscure. On p. 305 we note the mathematical terms sine and cosine incorrectly used.

Finally, we arrive at Chapter 8, "Use of Organic Forms in Melody." This chapter contains a most stupendous mathematical error. Schillinger again discusses the "summation series" mentioned earlier, the sequence 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144 . . . which he now calls the "Fibonacci Series." He then proceeds to present a geometrical construction which he claims will give these numbers. The construction is shown in Fig. 103, p. 330, with the above sequence of numbers written along the bottom of the figure as though they resulted from the given construction. Any good high school trigonometry student could show that this diagram is nonsense; it does not at all give this sequence of numbers. In fact, the indicated construction cannot possibly produce a summation sequence; a simple calculation shows that it produces a sequence of numbers each of which is 3/2 the preceding, and is there-

fore a geometric progression.[4] It is inconceivable that anyone who claims to know mathematics could make and publish a mistake of this magnitude.

Another error in elementary physics occurs on p. 359. Schillinger gives the vibration-ratios for the diatonic major triad as 4:5:6, which is correct, and in the same sentence gives the ratios for the minor triad as 5:6:15, which is quite wrong, and the ratios for the dominant seventh chord as 4:5:6:7, which is also wrong. His physics is obviously no better than his mathematics.

We need not waste time on the remainder of the work. We continue to see formidable arrays of formulas and graphs, but the actual mathematical content remains infinitesimal.

One might hope that Mathematical Basis (Schillinger's "masterwork") would contain some of the illustrative material so lacking in Composition, material necessary to lend some validity to the assertions made and to raise the work at least somewhat above the level of numerology. Unfortunately, a study of Mathematical Basis reveals nothing more than the same pseudo-mathematical jargon and extensive numerical working out of trivial mathematical formulas. The numerology is extended to cover art and design as well as music; the sections on music are copied verbatim from Composition, and the whole hodge-podge is given the impressive title, "Theory of Regularity and Coordination."

We conclude finally that Schillinger's claim to have established a scientific and mathematical basis for music and the arts is nonsense. What little science and mathematics we find is trivial when not actually erroneous. Assertions regarding the aesthetic superiority of certain arbitrary procedures must be taken on faith, since the musical data necessary to establish their validity are lacking. The essence of the scientific method is the resort to observation and experiment to test the correctness of theory and hypothesis; one finds none of this in Schillinger's work.

Mathematical Basis was first introduced to the author by a musician acquaintance of the Hollywood school, who commented in awed tones on the vast amount of science and mathematics it contained. However, a strong "crackpot" odor was evident on the first examination, and was confirmed on more detailed subsequent investigation. Judgment in this instance was facilitated by experience with similar material in the field of physics. Science departments in universities are continually bombarded with communications from individuals proposing new and revolutionary theories which they have developed. Much of it is nonsense; the remainder can be refuted by anyone with an elementary training in science. This scientific insanity has certain characteristics which usually enable one to classify it immediately.[5] One of these is a wordy and confused style which can sound important but

4. The only positive term summation sequence which is also a geometric sequence is the one beginning with the two terms a, $\frac{a}{2}(1+\sqrt{5})$.

5. For an interesting and amusing account of some of the absurdities propounded as science, see Martin Gardner's Fads and Fallacies in the Name of Science, Dover Publications, Inc., New York.

means nothing when analyzed. A second is its isolation; your pseudo-scientist develops his theories alone, not utilizing the work of others in his field as a foundation for his own. The average scientific paper is crammed with references to other papers; the pseudo-scientific publication disdains them. In fact, a third characteristic of the "crackpot" is the contempt he has for the predecessors and co-workers in the field he is revolutionizing. Schillinger's work has all of these characteristics. As such, it is just the sort of stuff to appeal to pseudo-musicians, low-grade composers, semiconductors (the term semiconductor has become very important in physics, and might be useful in music as well), and the like.

Of course, if anyone finds Schillinger's methods useful in the composing of music, by all means let him use them. A composer is certainly free to use a prime number series or a number from the telephone directory (see p. 491) in his work if he wishes, but the result must withstand judgment as music and not be claimed somehow superior because prime numbers or telephone numbers are contained in it. Schillinger's methods have no scientific or mathematical foundation, and to claim they have is to perpetrate a fraud on a defenseless musical public.

References

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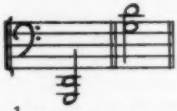
2. The Musical Quarterly, Vol. 32 (1946):465.
3. Music Library Association Notes, Vol. 4 (1947):183.
4. Music & Letters, Vol. 28 (1947):389
5. U. S. Quarterly Booklist, Vol. 2 (1946):272
6. The Nation, Vol. 163 (1946):332.
7. The Music Review, Vol. 8 (1947):311.
8. Music Library Association Notes, Vol. 3 (1946):274.

RE: FUNCTIONAL AND NON-FUNCTIONAL DISSONANCE

By Nicholas Temperley

In the November 1959 issue of the Journal of Music Theory Mr. Richard Bobbitt has drawn a distinction between "functional" and "non-functional" dissonance. His application of this to the theories of earlier writers has cleared up some ambiguities that surround the question of dissonance. Unfortunately, he himself has confused the two types of dissonance. He has set up a new measure of non-functional dissonance called "intervallic density" which assigns fixed "density" values to intervals regardless of their pitch register, thus introducing a characteristic of the functional concept of dissonance. Rules of counterpoint ignore pitch register in dealing with dissonance. But any such "non-functional" theory of dissonance must take cognizance of the undoubted fact that a given interval, taken out of any musical context, certainly does not sound equally dissonant at all registers. Helmholtz's theory takes cognizance of this; Mr. Bobbitt's does not. Thus, according to Mr. Bobbitt, these two intervals are equally "dense" (that is, they are equal in non-functional dissonance):

But according to Helmholtz,[1] the first is dissonant (because the frequency of the wave resulting from the combination of its tones is less than 33 cps — in fact, about 24) while the second is not (because its resultant frequency is about 96). Helmholtz's theory agrees with intuitive judgment, and also with the established practice of avoiding the use in a low register of intervals which would otherwise be acceptable. Any theory which suggests, as Mr. Bobbitt's does, that intervals have a fixed non-functional dissonance regardless of pitch register is automatically suspect.

Mr. Bobbitt defines non-functional dissonance as "density," a quantity which he derives from a feature of wave superposition. In Diagram 4 of his article (p. 184) he shows the sound waves of two tones whose frequencies are in the ratio 3:2 (i.e., they are a fifth apart), together with the resultant wave which is produced when these tones are sounded together. He points out that the intersections of the resultant wave with the two original waves fall into a repeated periodic pattern. The successive periods between intersections are in the ratio 2:1:1:2, and this pattern is repeated indefinitely.

But Mr. Bobbitt seems to forget that these "intersections" have no real existence. They can be seen clearly enough on the diagram;

1. Hermann L.F. Helmholtz, On the Sensations of Tone....Tr. by A.J. Ellis. Second English Edition. New York: Dover Publications, Inc., 1954, pp.191-2.

but the diagram presents on one graph three waves which never in fact reach the ear as separate entities. All that reaches the ear is the "resultant" wave. The intersections of this wave with the two waves of the original tones are, therefore, mere abstractions. How can they affect the hearer's impression?

However, let us assume that the ear not only can "perform a Fourier analysis" on the complex wave it receives, that is, break it down into the component waves, but also can perceive the "intersections" between these component waves and the resultant wave. Even so, there are still insuperable objections to Mr. Bobbitt's theory. For he treats the pattern 2:1:1:2 as characteristic of the interval presented in the diagram, whereas in fact it is nothing of the kind. The diagram presents only a special case of the interval 3:2, where both component waves reach zero amplitude at the same moment. The pattern 2:1:1:2 belongs to this special case alone. If wave B, for example, reaches zero amplitude 1/28 of a second later than wave A (i.e. if it is shifted one square to the right in Mr. Bobbitt's Diagram 4 — see the diagram on p. 235 opposite), the intervals between the intersections become $\frac{1}{20}$, $\frac{7}{60}$, $\frac{2}{15}$, $\frac{1}{30}$, and $\frac{1}{6}$ sec. respectively, giving a ratio pattern of 3:7:8:2:10 (recurring). By similar shifts, the periodic ratios can be altered to almost any desired amount; the only constant feature is the number of intersections, which is always five[2] for the interval 3:2. Yet these shifts in no way alter the nature of the interval, which is a perfect fifth regardless of the relative phase of the two component waves. Clearly, then, the ratio pattern 2:1:1:2 is not specially characteristic of the perfect fifth.

Yet this is precisely how Mr. Bobbitt treats it. For example, on p. 198 he says:

> ... the density pattern of a perfect fifth (2112, totaling 6 fluctuations) doubles itself when inverted to a perfect fourth (312213, totaling 12 fluctuations).

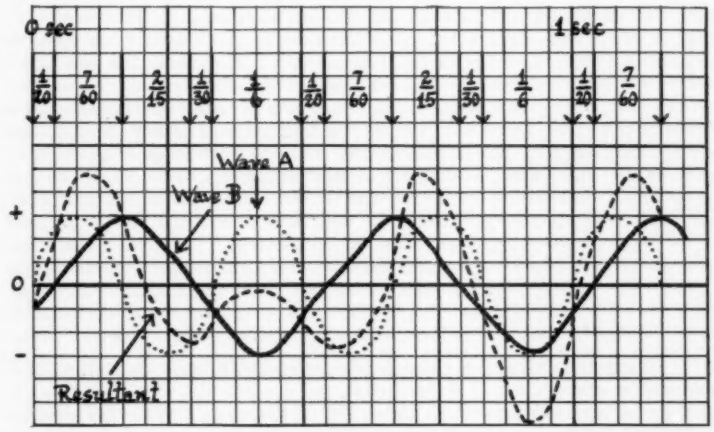
This is quite meaningless. The "total" of the numbers 2112 can have no significance whatever, and they certainly do not represent "fluctuations" of any kind. But Mr. Bobbitt works out these "periodic complexity patterns" for all the intervals from the unison to the octave, always taking the special case where the two tones of the interval reach zero amplitude simultaneously. He tabulates these on p. 191, and treats this table as a "density scale." The more complex the pattern of an interval, the greater the interval's "density," i.e. non-functional dissonance.

Considering that these patterns are not characteristic of the intervals they represent, one would not expect them to yield a significant measure of the intervals' non-functional dissonance. Nevertheless, a glance at Mr. Bobbitt's table shows that his process ranks the intervals in an order very similar to the traditional one, starting with the unison

2. In the special case considered by Mr. Bobbitt, the five become four, because two of the intersections coincide. He should have called the periodic pattern 0:2:1:1:2, not 2:1:1:2.

and ending with the tritone. Why is this? The answer is that Mr. Bobbitt's criterion of the "complexity" of the patterns is apparently the number of numbers in the pattern, not the size of the numbers. For example, the "patterns" for minor third, minor sixth, and minor seventh are all made up of the numbers 1, 2, 3, 4 and 5. Yet he does not rate these intervals as equally "dense"; in Table II, on the contrary, he places the minor seventh in a different group from the other two. Clearly he regards the number of numbers in the pattern as the primary consideration. This is, of course, the number of "intersections" in each cycle of the resultant wave. Adding 1 to this number to take account of the fact that two of the intersections coincide in Mr. Bobbitt's special case, we have the number of intersections in the general case for each wave. The number of intersections is simply the sum of the two numbers defining the interval. (Thus for the perfect fifth, 3:2, there were 3 + 2 = 5 intersections.) The number of intersections will therefore be small when the two numbers defining the interval are small; that is, when the two frequencies are related by a simple arithmetic ratio.

In other words, Mr. Bobbitt's "density scale" is based on nothing other than Pythagoras' criteria for consonance and dissonance. It is scarcely surprising that his order does not differ from the traditional one.



BOOK REVIEWS

Edited by
George H. Jacobson

HARMONIC MATERIALS OF MODERN MUSIC. By Howard Hanson. Appleton-Century-Croft, Inc., New York, 1960, 381 + XV pp., $6.00.

Like Luigi Cherubini and Nikolai Rimsky-Korsakov, both of them composers and musical directors, Dr. Hanson has added to a similar doubly distinguished career a contribution to the theory of music. Harmonic Materials of Modern Music is the result of more than "a quarter-century of study of the problems of the relationship of tones," and represents a compilation of "all of the tonal materials of occidental music, classic and modern, serious and popular."

Dr. Hanson's field of study is the equal-tempered chromatic scale, the elements of which represent twelve enharmonic pitch classes. His aim, a formidable one, is the generation and classification of all tonal relationships within the limits of this scale. The material is presented in two forms, the sonority and the scale. Neither of these is defined, but it would seem that the sonority is any simultaneously sounded collection of pitches, and that the scale is any series of pitches, usually five or more, arranged in an ordered, predominantly stepwise, ascent or descent. Often the term, "melodic (or harmonic) material" is used instead of scale (or sonority).

Anyone who would tackle the chromatic scale with such a purpose in mind deserves sympathy and understanding from the start. It is only in comparatively recent years that this scale has achieved bona fide status as an independent entity, but even so, it still bears the marks of its earlier prolonged affiliation with and dependence upon the organizing powers of the diatonic system. Those theorists who would wipe the slate clean invite hazards created by our heritage, by our unwitting but persistent habits of hearing, and even by our composing in ingrained ways. Dr. Hanson, like Paul Hindemith in his Craft of Musical Composition, has taken on the task of providing a universally applicable rationale. But unlike Hindemith, he has excluded any systematic discussion of the manner in which the classified materials might be used, possibly because the styles of music that he has in mind, if we judge by the quotations from the literature, range from those that are clearly tonal, even diatonically oriented, to those that are so infused with Wanderlust that they can, and have been called pan-, a-, un-, or not-tonal. Hence, degreeish-ness is not necessarily a quality of any of his scales and sonorities, but it is also not ruled out.

Diatonic scales are essentially unruly, with their half steps here and whole steps there. By contrast, the smooth uninterrupted flow of half steps that comprise the chromatic scale seems to be the essence of order. Its octave can be readily divided into equal seconds, thirds, fourths, or fifths. It is easy to conclude from the observation of such neatly organized patterns that all features of the chromatic scale can

be reduced to similar patterns. In any event Dr. Hanson's method aims at the reduction of all tone combinations of the chromatic scale to multiples of like quantities. Dangers exist in such a procedure, for while the results may turn out to be completely satisfying in terms of the adopted method, they may prove to be out of kilter with our daily experience. Where the organizing logic of many of us in dealing with the chromatic scale is apt to be inductive, even seductive or opportunistic, Dr. Hanson's logic is almost exclusively deductive. The characteristic, "If... then" sentence structure is apparent throughout, and support of various arguments comes from the deductive procedures of simple arithmetic and geometry. The questions that must be asked constantly are: To what degree are the premises and conclusions in accord with experience? Are the conclusions of universal value or do they represent limited and limiting cases? Because so many of us remain nomads in the realm of the duodecad it will be wise to inquire into each of the main elements that form the system of Harmonic Materials.

The primary element of Harmonic Materials is the interval (doad). All doads are reduced to six by regarding an interval and its inversion as identical, and by equating all enharmonic pairs. The interval symbols employed throughout are, p m n s d t, usually in the order here given, whereby p means the perfect fifth and the perfect fourth, m means the major third and minor sixth, n the minor third and major sixth, s the major second and minor seventh, d the minor second and major seventh, and t the tritone and diminished fifth. Such intervals as the augmented second, diminished fourth, augmented fifth etc., are grouped in their respective enharmonic places in the "six basic tonal series."

Certain questions follow upon these first decisions of Dr. Hanson. Although the fourth, for example, can be regarded as the inversion of the fifth, it does not follow that all fourths are to be thought of in this manner. Further, even when the fourth is to be so considered, there remains an important qualitative difference between it and the fifth. Also the fifth in certain contexts partakes so much of the character of the fourth that it might easily be regarded as its alter ego. So far as enharmonic relations are concerned, a very complex situation exists generally, which is made more complicated here by the fact that Dr. Hanson, as noted, seems to have in mind all styles from those that are unabashedly tonal to those that are resolutely not tonal. In a diatonic style differences between enharmonic pairs are real; as chromaticism increases enharmonic pairs tend to merge. This distinction is not exclusively historic, nor does it disappear in equal temperament, since musical context rather than a tuning system creates the distinction. None of these factors plays a part in Dr. Hanson's treatment of intervals. Like so many theoreticians, he assumes absolute conditions in an area where variable conditions are paramount.

Because the order p m n s d t is preserved throughout the book, excluding small oversights, it can be assumed that Dr. Hanson has in mind some kind of qualitative distinction among interval groups. This distinction is treated neither extensively nor systematically. There is, beginning on p. 106, a brief general discussion of the roles of consonance and dissonance, as often defined, in determining degrees of

tension, but no clear decision is reached. Elsewhere there is mention of "sensuously luxuriant sounds," of "the mildest of gentle sounds," of those that are "grimly ascetic," "savagely dissonant," but no identification follows, nor was any intended, apparently. Other occasional remarks make it clear that although traditional distinctions between consonance and dissonance are accepted, traditional rules of syntax are not. Of course, a closer examination of traditional descriptions would reveal striking discrepancies, even in distinguishing consonances from dissonances.

The core of the book is concerned with four topics: Interval Analysis, Projection, Involution, and Complementary Scales. "Interval Analysis," as can be gathered from the preceding paragraphs, is not interval analysis at all, but rather interval counting, a method of determining quantity rather than quality. The major triad, for example contains a perfect fifth, major third, and a "concomitant" minor third. Its symbol in Harmonic Materials is a purely quantitative p m n. The minor triad contains a perfect fifth, a minor third, and a concomitant major third. Its quantitative symbol is therefore the same, p m n. Dr. Hanson is of course aware of a basic but unrecorded qualitative difference, but for a reason to be examined presently, in connection with the topic, Involution, he does not indicate it, nor does he record similar differences in the case of other sonorities and scales. For multiple representation of intervals in a given sonority or scale, appropriate arabic numerals are placed to the upper right of the symbol. Thus the twelve tone scale is symbolized as p^{12} m^{12} n^{12} s^{12} d^{12} t^{6}. When there are quantitative differences in the interval count of sonorities and scales they are classified by the intervals that are most numerously represented. Thus the series, C-D-E-G-A-B, the interval count of which is p^5 m^2 n^3 s^4 d, is known as the perfect fifth hexad. As we shall see, methods of generation also play a role in identifying a series or sonority.

"Projection" is a procedure that operates to generate and to classify sonorities and scales. As a generator its simplest use is in the superimposing of like intervals from a base or starting tone, usually C. Thus, two perfect fifths projected upward from C as a base create the triad C-G-D, its identifying symbol being p^2s regardless of the eventual distribution or doubling of the three tones (i.e. C-G-D, C-D-G, D-G-C, G-C-D in any doubling). Systematically, each interval of the basic six is projected in varying numbers. And by extension, triads, tetrads, etc., may also be projected at various intervals. Thus two major triads built a perfect fifth apart (e.g. C-E-G and G-B-D), known as p m n @ p, or according to interval count, p^3 m^2 n^2 s^2 d, generate the series or scale, C-D-E-G-B, and also classify it.

Eventually, groups of different intervals are projected simultaneously, such as perfect fifths and major seconds. Thus the projection of two fifths from C (C-G-D) and two major seconds from the same tone (C-D-E) produce the tetrad (p^2 m n s^2), C-D-E-G, the generating symbol (as distinguished from the total interval count) being p^2 s^2, as employed by Dr. Hanson in analyzing a theme from his Romantic Symphony, or $p^2 + s^2$ as suggested on page 43.

Interval analysis or the quantitative measure of sonorities, and

projection or the formation of sonorities and scales by the duplication of an interval or a pair of intervals are the primary generating and classifying agents of Dr. Hanson's study. His continued reliance on them gives rise to many puzzling questions. Interval analysis gives us only a gross undifferentiated count of interval content. As previously noted, it fails to inform us of the variable significance of intervals.

So far as Projection is concerned the weakness of this kind of generator stems from the tendency to account for various pitch relationships in a limited and limiting manner. This deficiency is revealed in many of the analyses. For example, a brief excerpt from Gustav Holst's Hymn of Jesus, quoted on p. 199, consists of an E major triad which is followed by a $B^{\flat}$ minor triad. The tones employed in this triad succession, arranged in scalar fashion, are $E\text{-}F\text{-}G^{\#}\text{-}B^{\flat}\text{-}D^{\flat}$. It is difficult to understand what kind of enlightenment is gained by analyzing the tones and presumably accounting for the passage in terms of the projection of two diminished triads a perfect fifth apart ($B^{\flat} - D^{\flat} - E$ and $F - G^{\#} - B$), for there is no demonstrable priority of generation to be found in such a construction. This must be the first time that the devil in music has been exorcised before the altar of the major and minor triads. Actually, in this and most of the analytic excerpts, Dr. Hanson is saying in effect that the tones employed in such and such a manner by the composer are the same as those generated in a different manner in Harmonic Materials. The relationships thus created between excerpt and commentary are casual and obfuscating rather than causal and enlightening.

Of course, Dr. Hanson knows at least as clearly as your reviewer that there is a discrepancy between Holst's and many other composers' quotations and the commentary. But the system comes first, and this means that an analysis that rests on the projection of like quantities (two diminished triads) must be advanced as the rationale of a passage palpably created out of the juxtaposition of unlike qualities (a major and a minor triad).

An interesting case, not without precedent, is Dr. Hanson's generation of the diatonic scale out of the projection of six fifths, the result of which is a Lydian-like mode or heptad. It is pointed out in Harmonic Materials that by starting the resultant series from successive pitches all of the diatonic modes will be arrived at. This is true, of course, but the question remains, why is the Lydian mode made the starting point, when we know from experience and history that this position, once bestowed on the Dorian mode, was given to the major mode in the 16th century and, for defensible reasons, never thereafter relinquished by it. The answer is that only the Lydian mode can be generated by an upward projection of six perfect fifths, that is, six like intervals. Hence it becomes systematically the first, although in experience it is far from that. This should be a disturbing contradiction.

As might be expected, there are times when reasonable agreement can be found between quotation and analysis. This occurs when aspects of the compositional technique happen to agree with the particular generating technique employed by Dr. Hanson. A case in point is the major second hexad ($\underline{m}^6\ \underline{s}^6\ \underline{t}^3$ in terms of interval count, $\underline{s}^6$ or

$\underline{m}^2$ $\underline{s}^2$ $\underline{t}$ in terms of generation). Any number of excerpts might have been found as samples of this kind of hothouse vegetable, known commonly as the whole-tone scale, and also called such by Dr. Hanson. The basic assumption, doubtless bolstered by so simple a case, is that all of the many fragments of the chromatic scale can be accounted for by means of the limited projection methods of Harmonic Materials.

A third general topic pursued by Dr. Hanson is called by him, "Involution." It is elsewhere known as contrarium reversum, mirror inversion, or as employed by the 19th-century Chicago theorist, Bernhard Ziehn, symmetrical inversion. This device, which has become the sacred cow of many serialists, spends itself in identifying the exact downward reflection of a given upward projection. By this action it is assumed in Harmonic Materials that a system-building relationship exists between the original upward projection (let us say, C-E-G) and the downward projection or involution (that is, C-A^b-F). As pursued in Harmonic Materials, the three products of involution are: "simple," wherein the mirroring technic gives rise to a different sound from the original, as in the case just cited; "isometric," wherein the product is the same, in sound, although not necessarily in pitch, as in the case of the major triad with the major seventh (C-E-G-B produces C-A^b-F-D^b by involution); and "enharmonic," wherein the sound of original and mirror is the same, but the notation is enharmonic (C-E-$G^\#$, i.e. two major thirds up from C has as its reflection, C-A^b-F^b, i.e. two major thirds down from C). Beyond this, many sonorities and scales are accounted for by simultaneous upward and downward projection of like intervals or groups of like intervals, as in the case of the alternate generation of the whole-tone scale, just cited.

Old skeletons rattle at this suggestion of harmonic dualism. The attempt to explain the minor triad as a natural phenomenon based on a putative "undertone series," the mirror of the partial series, collapsed many years ago, and it should not be necessary to review the reasons here, except to report that Dr. Hanson wants his minor triad to be the involution of the major (or vice versa, for that matter) but he rejects the consequences. In brief, his minor triad is to be heard from the bottom or bass upwards, in terms of root, third, and fifth, rather than from the top down, which would be the inevitable consequence of a mirrored generation.

Involution or generation by reflection is a device of limited value. Among those panchromaticists who have no other guidance, its use provides a measure of assurance. In any tonally oriented music the negative or minus values that characterize the mirror image provide nothing more than something to depart from in the face of more fundamental shaping forces. In brief the "real" image has achieved a position of priority over the "tonal" image almost exclusively in serialists' computations alone. Elsewhere it has not operated effectively as a generating force. If it had, we would be more mindful of the relationship between the major and so-called Phrygian modes, for one is the involution of the other, despite Dr. Hanson's misleading statement on p. 33f. And similarly, the mirror of the minor mode is the "Mixolydian." But to what degree has the world of tones been shaped by this fact? Further, and Arnold Schoenberg's Opus 33a notwithstanding, there are

simple, direct ways of relating the dominant seventh sound to the sound of the minor supertonic seventh, ways which achieve immediate and lasting precedence over the casual fact of their mirrored relationship.

Dr. Hanson points out that a sonority or scale and its involution always have the same interval count despite qualitative differences. For this reason, p m n stands for both the major and minor triad, as noted earlier. However, as indicated in Harmonic Materials, not all sonorities and scales with the same interval count are involutions of each other. There is a limited number of strange pairs such as C-E-$F^{\sharp}$-G and C-$F^{\sharp}$-F-$B^{\flat}$ that are quantitatively identical (p m n s d t for the pair here cited) but do not mirror each other. Employing a term borrowed from chemistry, these are called isomeric sonorities or scales, isomeric twins, or simply twins. Isomers are most numerous among hexads, where a total of eight are described. They are, in the terms of Harmonic Materials, nonisometric isomers as distinguished from other isometric isomers, and one of them has special peculiarities which leads to its being called a maverick. Later, a chapter is devoted to the "Maverick Sonority," but it is not quite the same thing, for it is comprised of tetrads, pentads, heptads and octads. No illustrations from the literature of music are cited for such a sonority or scale, which thrives on a kind of behind-the-barn miscegenation.

"Complementary Scales," the fourth topic of Harmonic Materials, are those pitches that are left over after the pitches of a doad, triad, tetrad, etc., have been withdrawn from the total of twelve. Hence, every doad has its complementary decad, every pentad, its complementary heptad, etc. Acting upon the assumptions that form the basis of "Interval Analysis," Dr. Hanson points out a basic feature of the relationship of original sonorities to complementary sonorities. It is that the intervals that predominate quantitatively in the original sonority will predominate in like manner in the complementary scale. Thus the triad, p m n, has as its complementary nonad, p^7 m^7 n^7 s^6 d^6 t^3.

However, the matter does not end here. In one of the few needlessly complicated pages of Harmonic Materials, it is pointed out that this complementary nonad can be thought of as a compound of five minor triads, known as the nine-tone projection of the (minor, in this case) triad. The principle evoked by this phenomenon is that "the nine-tone projection of a triad is the involution of its complementary scale." The application of the principle is subsequently extended to other formations.

How does the analyst, let alone the composer, make use of this information? On pp. 269-70, analytic reference is made to the four opening bars of Dmitri Shostakovitch's Fifth Symphony. Nine pitches are employed by the composer, leaving over three, which form the diminished triad, F-$G^{\sharp}$-B. "It becomes immediately apparent," writes Dr. Hanson, "that the complementary nine-tone theme must be the basic nine-tone minor third scale."

Actually, in these simple bars it seems much more relevant and informative to record the fact that, in a simple imitative style, Shostakovitch is trying to lead an initial suggestion of G minor into D minor, the D minor being confirmed in the two bar stretch that comes after the

quotation. Other analytic insights might follow on such a superficial but necessary initial observation, but none follow on Dr. Hanson's analysis, especially when one discovers that the nine-tone scale as built by him, after extracting it from the composition, consists of a diminished seventh chord (tetrad) built from C, to which another is added built from G, to which "a second foreign tone (D), a fifth above the first foreign tone (G)" is also added. These two "foreign" tones are, of course, the competing tonic degrees. Here again the analysis points out solely that the pitches struck by Shostakovitch in his way can be arrived at by Dr. Hanson in his way. No further relationship is to be found.

Another illustration can be found by starting with a fragment from Petrouchka, quoted on p. 128 of Harmonic Materials. It is the passage in the "Third Tableau" that follows immediately after the "Waltz in $E^{\flat}$." The cited quotation includes the four bars in which an $E^{\flat}$ major and a B minor triad are alternated rapidly. It is analyzed as a compound generated by two augmented triads a perfect fifth apart (classified as $\underline{m}^6$). The succeeding bars alternate similarly the $E^{\flat}$ major and an A major triad. Because the two triads are quantitatively and qualitatively identical, a direct analysis (your reviewer's) would be p m n @ t, that is, two major triads a tritone apart. But if all of the bars cited are brought together in order to gain a comprehensive view of the whole, a nine-tone scale results, $E^{\flat}$-E-$F^{\#}$-G-A-$B^{\flat}$-B-$C^{\#}$-D. The analysis of the opening bars offers an initial embarrassment, for it accounts for a major and a minor triad in terms of two augmented triads. The second part is consoling — two major triads are analyzed as consisting of two major triads. But the total picture clouds the issue again, for the nine tones are the nine-tone projection of the major triad. In order to construct this projection we must start with a G major triad and add to it others from B, $E^{\flat}$, D, and A. How does one reconcile the partial analysis involving augmented triads with the complete analysis, involving only major triads? How does one reconcile Stravinsky's major and minor triads with either of these? How does one reconcile a passage that takes its leave from, but recalls $E^{\flat}$ major, and makes its way clearly enough to B minor eventually, with a nine-tone projection of major triads starting from G, and showing a reasonably clear G major or D major orientation? There must be more direct analytic procedures somewhere.

Those who take on the task of studying Harmonic Materials need not be told that it was twenty-five years aborning. Careful planning and prolonged thought are evident throughout. As the system is developed and gears, levers, tubes, and pushbuttons are added, the subject matter becomes depressingly complex, but the expository style remains simple and, with very few exceptions, clear throughout. Aside from the passage on complementary scales, already noted, the definition and subsequent treatment of the "Connecting Hexachord" are not clear, nor is the term indexed. A working definition appears as a footnote on p. 269, but extended treatment does not begin until p. 305. For the rest, the premises adopted by Dr. Hanson are developed with consistency and cogency so far as the system is concerned.

The methods of Harmonic Materials are not unique; they smack of

serialist orientation, including the favored retrograde inversion, but not called that or anything else in the way of a term, for that matter. But Dr. Hanson is not one to support twelve-tone methods of composition. In fact he finds opportunity to chide such methods on p. 33. Also the dedication of the book should be read. Yet this does not prevent him from lending a helping hand to "tone-row" composers in the Appendix to Harmonic Materials.

But there is a difference of purpose between serialists' aims and those of Dr. Hanson. Where the serialists seem to be working compositionally, that is, devising a structure that might be valid for a given piece, Dr. Hanson is aiming at a universally applicable organization. The serialist proceeds from the individual composition to generalizations about serial music; Dr. Hanson proceeds from generalizations of presumed universal value to the particular piece. Perhaps it is for this reason that the relation of the system to music, at least in the cases of most of the examples cited in Harmonic Materials, remains peripheral. Yet, a brief but interesting suggestion of how a composer might avail himself of the material of this book is supplied, perhaps unwittingly, by Elliott Carter on pp. 194-5 of the April, 1960 issue of The Musical Quarterly. If this is an augury, perhaps our children will thrive on Dr. Hanson's system. The gain will be Pyrrhic.

WILLIAM J. MITCHELL

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THE THEORY OF CLASSICAL GREEK MUSIC. By Fritz A. Kuttner, with the assistance of J. Murray Barbour. Musurgia Records, New York, 1955, $8.50.

MEANTONE TEMPERAMENT IN THEORY AND PRACTICE. By J. Murray Barbour and Fritz A. Kuttner. Musurgia Records, New York, 1958, $8.75.

THE THEORY AND PRACTICE OF JUST INTONATION. By J. Murray Barbour and Fritz A. Kuttner, Musurgia Records, New York, 1958, $9.25.

In spite of the expressiveness of language, the basic element of music, pitch, defies an exact description in terms of language alone. The musician must resort to such terms as "like" something, borrow expressive adjectives from the other arts, or compare one pitch to another, e.g. "higher than" or "lower than." Even vibration frequency is meaningless without a reference instrument. When we refer to an "exact" pitch, such expressions as "a little sharp," "a little flat," "out of tune," or even "in tune" are necessarily vague. Is "out of tune" with what? What is "in tune?"

When we define intonation we must have a standard of some kind, and although we might assume that the equal tempered scale is here to stay, experimentation will quickly prove that practicing musicians use a great many systems of temperament, very few of which agree completely with equal temperament. So the intonation of intervals and

chords is still debatable; it will vary with instruments, chord functions, key, etc., and the question finally retreats into the psychological vacuum of "feeling" without being answered.

While this set of records can tell us the sound of various systems of temperament and the sound of music performed according to each system, our judgement is still influenced by what "sounds better," without any other criteria. There is no such thing as an absolute standard; it depends upon what we choose to accept as an absolute standard, together with its limitations and what we casually refer to as its "imperfections."

In the three records so far released, more than one hundred examples of various tunings are demonstrated, including equal temperament. The authors point out that while many of these tunings are theoretical, a few enjoyed actual use, and that just intonation — believed to be the ideal solution to the problem by many theorists and musicians — ". . . may be fully attainable in some acoustical fourth dimension."

The preliminary pages of each of the volumes which accompany the recordings (Sections I-VIII) are almost identical, and constitute the foundation on which each of the three volumes is based.

Section I, "Definition of Pitches and Intervals in Cents," gives a brief explanation of the system of logarithmic calculation of intervals in terms of cents proposed by Alexander J. Ellis in 1885. This system is generally accepted today and has become an "indispensable tool for all inquiries into musical acoustics, historical intonations, exotic, primitive and ancient musical scales." Those readers not familiar with the cent system will require supplementary explanations, as provided in the bibliography.

Section II deals with "A Short Survey of the History of Greek Musical Theory" (called "The Pythagorean Tone System in Antiquity" in Volumes II and III, which more accurately defines its contents.) As a survey, it is necessarily brief, and unfortunately, undocumented. An occasional reference to a "natural" third in connection with the discussion of Didymos and Ptolemy, as well as the statement that these men and their contemporaries knew more about the harmonic series than we are willing to give them credit for, are somewhat confusing to the reader until he realizes that by "natural" the authors mean "based on superparticular ratios." If there is evidence that either Ptolemy or Didymos actually knew of the harmonic series, it is not cited. Nor is a superparticular ratio "natural" because of its association with the harmonic series.

Section III, "Methods Used for the Preparation of this Recording," justifies the choice of medium: a small practice harpsichord with only one string per key, made by John Challis, with the addition of an electric organ (unnamed) for Volumes II and III. The author's justification is sound, and the recordings themselves bear out the accuracy of his judgement. By means of a stroboscopic frequency meter, the tunings are accurate within one cent, and "A," the center of reference for all intonations, has been kept at 440 cps for an absolute pitch. Although playback may be responsible for a variation of "A," all intervals and relative pitches remain precise within plus or minus one cent.

Section IV, "Listening to the Recording," offers the first of two reasons for making the recordings. Having warned that "our modern ears have become lazy and indifferent by contemporary listening diet which consists of nothing but equal temperament intonation and its admixtures of 'Pythagorean' and natural intonations," we are told that "a few hours of concentrated listening and many repeated hearings of the demonstrated examples will normally be required, before a clear and sensitive definition of the sound phenomena begins to form." As if this were our goal, the author continues: "The results of this short period of training and preparation are always gratifying: a new sense of interval and intonation values develops, together with a keenness of discrimination which is very useful to the singer and instrumentalist alike, and highly stimulating to the critical observer and listener." However this may be, our "lazy and indifferent" ears, also called "modern ears," are called upon to make a good many arbitrary decisions based on preferences in the examples of the various intonations which follow. Nor is it a matter of "a few hours of concentrated listening," for, according to p. 26, the "process of converting listening habits (in regard to non-Western music) takes normally several years of acclimatization to unusual intervals." Various references are made to tests which the author has conducted at some time in the past and whether it is a matter of hours or years, even the author seems to be unsure.

Section V lists a few "References" for each Volume.

Section VI, "The Pythagorean Tone System Twelve Cyclic Steps Upwards," Section VII, "The Pythagorean Tone System in Medieval and Renaissance Usage," and Section VIII, "The Divisive System," all deal with Greek tuning theory. There are excellent tables and diagrams, and with the conversion of cyclic ratios into cents, the explanation is entirely adequate.

Thus end the introductory pages for all three volumes. Continuing in Volume I, are the commentaries to the recorded examples, thirty-eight in number. There are three examples of Pythagorean intonation in the practice of the Middle Ages and Renaissance period, and four examples of Pythagorean intonation applied to organum and early polyphony. The first few of these examples are designated as "ear training in micro-intervalic pitch discrimination."

The remainder of the examples of Volume I are devoted to Greek theoretical tunings, including a number of different scales, further discussion of Greek music theory, and various performances of three of the Greek relics. Most inadequate is the discussion of mode, which the author himself has found to be inadequate in other sources, and which is more so here, in spite of his treatment. He believes that mode is almost entirely a matter of intonation, without which a diatonic mode is "an empty form without meaning." This is true even in Pythagorean diatonic intonation, and "it is for this reason that Medieval and Renaissance music failed to develop a modal theory that could really be called significant, original in its own right and independent from Greek thought." However, "as soon as we realize that the ordinary Pythagorean diatonic was only one of dozens of Greek intonations . . . a mode takes on an overwhelming significance." And, ". . . every change of mode within the scale creates not only a new scale, but it seems almost

a change of national, racial or territorial character of the scale in the melody." As a result, we are told that modal writing decreased until its disappearance altogether in the Baroque era, when "western music was content with the diatonic and chromatic scale in one single intonation and had to develop other complexities and sophistications: harmony, polyphony, orchestration."

Granted that intonation is extremely important in the history of music, it seems over-enthusiastic to maintain that it had quite such a major role in shaping compositional practice. (The author states, in Volume II, that he would be interested in an investigation of the methods of tuning and tempering and their influence on the rules of musical composition as they were developed during the Renaissance and Baroque eras; so apparently the matter is not settled.)

The second, and certainly the most important aim of this recording is "to present living sound, in the hope that this might contribute to a better understanding of Greek music theory the same way as the learned arguments of scholarly philology or musicology." One cannot help but agree with this justification, and only through the medium of a recording could such a purpose be accomplished.

Volume II, dealing with meantone temperament in theory and practice, both benefits and suffers from the same kind of treatment found in Volume I. There is an excellent exposition of the practice of meantone tuning, various recorded examples of intervals and scales, and 16 examples of compositions from the 16th, 17th, and 18th centuries, performed in various scale tunings.

Volume III deals with the theory and practice of just intonation, and although it includes 17 compositions recorded in various just intonations, we are told that "the inclusion of these examples is not intended to imply that these were so performed at the time they were written, for it is very doubtful that this tuning system was ever of practical importance." In conclusion: "There is no such thing as just intonation, but rather many different just intonations. Of these, the best is that which comes closest to the Pythagorean tuning. The practical western musician need but recognize it for what it is, and keep it firmly in its place: in the studies of archeo- and ethno-musicology, and in the textbooks on musical acoustics."

Here we have just intonation "debunked," and except for string and wind instruments, and to a certain extent, vocal music, there is no doubt but that the author is absolutely correct. Those adherents to a "natural" theory of music would cling to just intonation as the only manifestation of a natural theory of music, even though its imperfections would make it almost completely impractical in practice. The author states that "Zarlino, Mersenne, and Rameau, presented just intonation as the theoretical basis of the scale, but temperament as a practical necessity." This statement is only partially true. All three theorists, and many others, were led to some treatment of just intonation by way of their use of superparticular ratios, and the need for superparticular ratios in any kind of harmonic theory. However, superparticular ratios and just intonation are two different things, even though they seem to share basic elements. All three were "natural"

theorists, and derived natural theories of harmony, and, in the case of Rameau, of scale. But the recognition of the need for temperament in no way destroyed the harmonic theory based on superparticular ratios nor the theory of scales which resulted.

All things considered, this set of recordings and the accompanying volumes, are well done, and extremely valuable to the historical theorist. Five additional records are in preparation, including irregular temperaments, Chinese music theory, Arabic music theory, Indian music theory, and one dealing with quarter-tone music and other modern experimental scales. All volumes are based in great part on J. M. Barbour's Tuning and Temperament; A Historical Survey, which is an almost essential reference for anyone who would use these recordings intelligently.

ROY T. WILL

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THE SENSE OF MUSIC. By Victor Zuckerkandl. Princeton University Press, Princeton (Oxford University Press, London), 1959, 246 pp., $6.00.

This book is not the continuation of Sound and Symbol, as one might have assumed from the implications of the author at the close of that work. Whereas Sound and Symbol was a philosophical study on the phenomenon of "music in nature," the present publication falls in the category of an introduction to music. The author's aim is to deal with questions in which the intelligent layman and, in particular, the liberal arts student might be interested, questions about the significance, the inner meaning of the most obvious features of practical music. On the one hand he tries to avoid going deeply into the professional disciplines of music theory and history, and on the other hand to write another music appreciation book. The six chapters deal with Melody, Texture and Structure, Meter and Rhythm, Polyphony, Harmony, and Melody and Harmony.

This is a highly valuable book, one which should be widely read, not only by music lovers whose relation to music consists mainly in listening to records and radio, but even by the not-too-advanced music student who has had some theoretical training. It may be that certain other books of the same general type present more factual material of one kind or another. What matters more than such factual presentation is that Mr. Zuckerkandl teaches the reader how to think about music and musical problems. Central to his teaching procedure is the posing of such questions as: What is going on in the tonal material? What do we hear in it? He raises these questions even with regard to basic phenomena such as melody, scale, key, etc. Occasionally this procedure is a little cumbersome, although by far not as cumbersome as in Sound and Symbol. However, it is to its great advantage that in the end the reader has acquired an almost artistic attitude towards music; and this is much more important than the acquisition of a mass of undigested "factual" knowledge concerning musical terms and rules. To give just one example: In the course of a few short analyses, the author

several times comes across the six-four chord on the dominant. He explains it quite succinctly as a constellation consisting of a bass tone with two embellishing tones above it, thus making sure that the reader understands the function, the behavior of this so-called chord. He deliberately avoids mentioning its name, on this occasion and elsewhere in the book, since this would only create confusion in the mind of the reader.

Of course, in a book of this kind occasional oversimplifications are unavoidable. Thus, we find (p. 80) that in polyphonic music, "taken individually each voice is a consistent melodic movement in its own right, makes sense by itself." One has only to play through the individual parts of any keyboard fugue by Bach to see that this is not so. And one would have to disagree outright with some of the ideas on phrasing, or with the statement (p. 153) that "there is disagreement with musical practice whenever the fourth is deemed dissonant." On the whole, however, the ideas brought forth are solid and valuable.

The language is clear and simple and the book makes excellent reading. The 32-page supplement of scores of the compositions discussed is reproduced from reliable editions. A tape of these compositions which can be obtained from the publisher, ought to prove valuable for classroom use and for those whose playing ability is poor. There are 19 examples ranging from Palestrina to Schubert, of which 8 are by the latter composer. No explanation is given for the one-sidedness of this selection nor for the fact that even the small examples in the text only occasionally go beyond Schubert.

The only authority specifically mentioned in the book is Heinrich Schenker (p. VII). His teachings are described as "the guiding light" and to be "in active presence everywhere, mostly under the surface..." They are very much under the surface indeed, since in the greatest part of the book Schenker's influence is hardly apparent, or else apparent only in a very general and vague way. One can hardly hold Schenker responsible, for example, for some of Mr. Zuckerkandl's ideas on harmony, no matter whether one agrees or disagrees with the author. Schenker's ideas apply mostly to phenomena of a more complex, more advanced nature which are beyond the scope of the present book. Only towards the end of the book does Mr. Zuckerkandl present a few analyses, with Schenker-type graphs, of six Bach Inventions and two songs by Schubert. Some doubts as to the correctness of these must be expressed. In the F minor Invention, which is a very difficult composition altogether, one cannot possibly read in the bass an uninterrupted octave-line from C to C (mm. 17-28). And in discussing Schubert's "Der Müller und der Bach" on pp. 212-213, Mr. Zuckerkandl describes the overall bass progression as I-III-V-I in mm. 1, 14, 18, 20, but tells us at the same time that after III, in m. 15, we go back to I. His graph presents the same contradiction. The fact is that the chord in m. 15 has a function different from a return to the tonic. It is equally confusing when, on p. 166, the author describes (correctly) the initial motif of the C major Invention as consisting of four notes C to F, whereas on the next page he explains why we have to hear F as a neighboring tone of the E's preceding and following it. The two readings are not entirely irreconcilable, but how is the uninitiated reader to find the

solution to such riddles?

To be perfectly fair, however, it must be said that such musical lapses are few and far between. In addition, it cannot be the main task of this book to present analyses of this advanced type. After all, can the reader who is in need of this book fully understand these analyses? Their purpose here seems to be rather to open up a view towards the higher regions of music, to give the reader an idea of what to expect should he proceed to advanced study. Seen in this light, such errors do not have the same import they would have in a textbook on counterpoint, for example, and therefore the occasional weaknesses do not detract from the book's usefulness. For a work of its kind, it is at an uncommonly high level.

ERNST OSTER

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K. Sakva, Director of the State Music Publishing House (Muzgiz) in Moscow, facilitated the transmission of the following review. Two aspects of the review should be of interest: (1) the discussion of a Soviet theory text which has been widely adopted, and (2) the viewpoint of the reviewer, a distinguished Russian musicologist. Forthcoming issues of the Journal will continue to include reviews of foreign publications. GHJ]

ELEMENTARNAYA TEORIYA MUZYKI. By Igor Vladimirovich Sposobin. Muzgiz, Moskva, 1959, 203pp. 5 R, 50 k.

The late Professor I. V. Sposobin (1900-1954) was a distinguished Soviet scholar and teacher of the theory of music. He was associated with the Moscow State Conservatory, named after P. I. Tchaikovsky, of which Sposobin was an alumnus. I. V. Sposobin and his colleagues, Soviet musical scholars and theoreticians, are the heirs of the glorious tradition of the Russian school which was founded by such giants of the musico-theoretical science as P. Tchaikovsky, N. Rimsky-Korsakov, S. Taneyev and A. Arenski. With their works in the field of harmony, counterpoint, instrumentation, and musical form, a realistic direction in the theory of music became established. Its goal was the continuation of the classical foundations of musical art. The theoretical studies of this group not only disclosed the principles of the classicists, but were designed to satisfy the needs of musical pedagogy, to solve the tasks of educating young musicians. This was the fundamental characteristic of the Russian musico-theoretical school: its linking of artistic practice with musical education. Thus the writers of theoretical treatises on music were composer-teachers who taught the subjects in musical theory in the conservatories during the second half of the 19th and in the beginning of the 20th centuries. Frequently their successors were also composers who gave considerable attention to teaching. Among these one may name, for instance, R. M. Gliere, whose pupil in the Moscow Conservatory was I. V. Sposobin.

Professor Sposobin directed all subjects in musical theory, yet in the last years specialized in teaching the course on harmony. On the

basis of his own teaching practice and the experience of other theoreticians, Professor Sposobin wrote a number of works which still are of great scientific significance and are pedagogically useful. Among these is a collection of exercises for solfeggio, published in the mid-thirties. In collaboration with a few professors at the Moscow Conservatory, I. V. Sposobin wrote The Practical Course of Harmony, in two parts, and Textbook of Harmony. The latter has been republished several times and at present is the basic textbook for courses on harmony in the music schools of the Soviet Union. In 1947 Professor Sposobin published the textbook Musical Form, also republished recently. In this book he treats not only the homophonic-harmonic forms but also polyphonic music. The last published work of I. V. Sposobin is the textbook, The Elementary Theory of Music, which appeared in 1951 and was later reprinted several times.[1]

As one may see, the studies of Professor Sposobin embrace — with the exception of instrumentation — all subjects belonging to the cycle of sciences on the theory of music. This is a result of the encyclopedic experience of an outstanding teacher and scholar.

The characteristic feature of the works of Sposobin is his reliance on a broad knowledge of musical literature. Each theoretical postulate is treated not in the abstract, but as a deduction from artistic practice. It is natural that the author uses primarily examples from Russian folk, classical, and Soviet music, although examples from Western European classics may be encountered at every step. This testifies to the fact that the author is a theoretician of great magnitude, one who makes generalizations about laws of the development of the musical art of the world.

Clarity of presentation is also an important feature of the works of Sposobin. An experienced teacher, he knows how to find a simple form for expressing a thought which is indispensable to the mastering of the subject matter. This applies fully to the book, The Elementary Theory of Music.

There is a vast literature on this subject, both in Russian and in other languages. There are numerous textbooks, both brief and detailed ones, books for beginning musicians and for amateurs; some of the works present only the formal rudiments of the theory of music, others stress the expressive facets of the musical element being studied, and so on. One would think that it had become difficult to state something new in this field. Still, Professor Sposobin succeeds in finding a novelty, and not as the fruit of a desire for originality for the sake of originality, but as a result of the general methodological approach, as well as from the broadly treated content of the subject matter.

The author links the course in elementary theory of music with other subjects of the theory of music. Precisely in that course the first steps are already made toward the study of the problem of content

1. All these editions were published in Russian by the State Music Publishing House [Muzgiz] in Moscow. Some of these books have been translated into other languages.

and form in music, even if in his own words "the scientific data of the elementary theory are not yet sufficient"[2] for the understanding of the combination of devices for musical expression.

The given definitions do not remain a simple declaration but are systematically followed throughout the book. The subject matter studied remains constantly under the influence of the thesis that music is essentially content, and that specific elements of the musical language are important as devices for expression. The remarks of the author on this point are very tactful and not obtrusive since he is addressing himself to the beginner who has not yet mastered the system of theoretical knowledge and demonstrations, but yet who cannot remain deaf to the general character of music.

Here are a few examples of such characterizations from Par. 37, entitled "The Meaning of tempo in music:"

> The meaning of the tempo in music is very great, as the character of the musical image determines the speed of the movement. For instance, the state of agitation is usually demonstrated by a fast tempo [musical example from the first movement of the Sonata in B^{b} by Chopin]. An animated dance, naturally, is expressed by a fast tempo of music [example from the finale of Grieg's Piano Concerto]. Fast or moderately fast tempi are frequently encountered in music expressing glorification or victory [examples from the Epilogue "Slavsya" from the opera Ivan Susanin by Glinka].

Similar demonstrations are to be found profusely in the whole book. Notwithstanding their brevity, one senses that these statements are made by a great musician who is educating beginners in the spirit of acceptance of the "contentfulness" of the art. It is a very important point that the devices of musical expression are treated by the author as being in a state of constant development historically, which gives the student a correct perspective and prepares him for the course in the history of music.

Of great importance are the author's polemical statements, directed against formalism in music, against the breakdown of melody, against the cultivation of dissonance for its own sake, and so on. He writes (p. 78) that the formalists "have completely lost contact with folk music, with the traditions of musical classicist-realists, and have forgotten the laws and norms of musical creation, perfected by the centuries-long development of the musical culture."

In Professor Sposobin's book the connection between the course in elementary theory of music and other theoretical subjects is insured primarily by a detailed discussion of the theory of modes. [The Russian term "lad" denotes scale, mode, tonality, and the concepts of modal and tonal. Thus, in the following section this term was translated in several ways, depending on the context. — Translator.] Of the fifteen chapters, seven are dedicated to the problems of tonal structure

2. I. V. Sposobin, The Elementary Theory of Music Moscow, 1951, p. 6. In the following all quotations are from that edition.

in realistic music. Besides having established that there is a logical continuity in the chain of musico-theoretical education, the very essence of realistic music requires that the beginning musician have at the outset an explanation of the richness of tonal structures, since without tonality there is no realistic music. In this way the author not only establishes the tonal foundation of music, but also fights against atonal music, dodecaphony, and all other tendencies which deny the importance of tonality.

Exactly in the chapters dedicated to the tonal structures, it seems to us, are concentrated the new elements introduced by Professor Sposobin, in the elaboration of the course in elementary theory. In spite of the fact that the statements are made on a popular level, the analysis of these questions is pursued very deeply, and richly illustrated with examples from the musical literature. Discussion is not limited to the major and minor modes with their modifications, or in comparison with one another; it embraces other natural modes and their intertwinings, known under the name of interchangeable modes, and, finally, it deals with various chromatically altered modal structures. A few of the definitions and concepts are introduced by Sposobin for the first time. This occurs, for instance, in the case of the determination of special types of mutability of modes (Par. 109), and the concept of "dominant mode of the minor key" (Par. 110).

From the material in the chapters dedicated to the modes there results the most important conclusion and principle of the inexhaustibility of artistic possibilities in tonal structures — just as in the heterogenous and figurative content of literary models. Objectively, this contradicts the statements of other theoreticians, formalists who are seeking justifications for the application of non-modal [or "non-tonal"] systems. And if it is possible to demonstrate that tonal music is very rich and diverse at such an early stage in the study of the theory of music, when only a few of the modes are being studied, so much deeper will this conclusion then be in the succeeding theoretical courses, when other, more complex, tonal systems are incorporated.

Establishing relationships with other subjects of the theory of music, the author introduces preliminary concepts of modulations and tonal plans, and in the last chapter concepts of musical syntax. In such a way a real connection is obtained between the course in elementary theory of music and the succeeding subjects. This is indispensable in the only system of the musico-theoretical cycle — that leading from the lowest grade to the highest, i.e. from elementary theory of music to the courses in harmony, polyphony, and analysis of musical compositions. In that respect the author relies on the basic scheme of musical education in the Soviet Union, which stresses gradual succession in the study of subjects of musical theory, starting from elementary schools of music and ending with conservatories.

From what has been said, it is clear that Professor Sposobin's book is the work of a great scholar and teacher, deeply interested in the education of the growing generations of musicians. It is intended for people who seriously study and love music, and who are able in the future to become musicians and disseminators of the best examples of folk, classical, and contemporary music. This book will be read with

benefit by the amateur, for it will help him to penetrate into the very essence of the musical art, and prepare him for the acceptance of artistic models. One of the clearest indexes of the substance of this book is its wide circulation: the editions of this book in the Russian language alone have surpassed 100,000 copies.

Vl. PROTOPOPOV
(translated by Miloš Velimirović)

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HEARING—GATEWAY TO MUSIC: A COMPLETE FOUNDATION FOR MUSICAL UNDERSTANDING. By Adele T. Katz and Ruth Halle Rowen. Summy-Birchard Publishing Company, Evanston, Illinois, 1959, 172 pp.

ELEMENTARY MUSICIANSHIP. By Alvin Bauman and Charles W. Walton. Second Edition. Prentice-Hall, Inc., Englewood Cliffs, N.J., 1959, 149 pp., $3.50.

MUSIC FOR STUDY: A SOURCE BOOK OF EXAMPLES. By Howard A. Murphy and Robert A. Melcher. Prentice Hall, Inc., Englewood Cliffs, N.J., 1960, $3.75.

It might be supposed that little would remain to be said about ordinary harmony, counterpoint, and form, or about matters so basic to all music study as rhythm, the harmonic series, intervals, scales, melodic and harmonic ear-training, and vocal and instrumental sight-reading. Yet it is quite as much in the area of elementary training as in the less explored area of contemporary practice that new textbooks continue to pour from the presses. Almost every preface expresses some degree of dissatisfaction with existing publications and launches the newest effort with the expressed or implied hope that the book in hand will serve the reader better than any existing work in the field.

As long ago as 1946 Paul Hindemith, in the preface to his Elementary Training for Musicians, was decrying the alleged inadequacies of the existing textbooks on Dictation, Sight-Singing and Sight-Reading, Ear-Training, Clef-Reading, and related matters, and was inveighing against what he considered the futility of trying to deal with these specialized facets of training in separate courses. That the publication of his comprehensive and admirable book — clearly designed for the thorough training of future composers, conductors, and performing artists — did not end the search for other approaches to the teaching of basic musicianship is attested by the publication of more recent studies. Among the latter we may mention a notable Introduction to the Theory of Music (W. W. Norton & Company, Inc., New York, 1956), by Howard Boatwright, himself a pupil of Hindemith and now a teacher of college undergraduates at Yale, and the first two books to be discussed in the present review.

My first observation on Hearing — Gateway to Music is that its sub-title, A Complete Foundation for Musical Understanding, may be slightly inflated. Whatever the virtues of this work may be, it can

scarcely be considered complete enough for the relatively mature student who, having committed his life to a professional career in music, finds himself in need of a full and systematic review of basic concepts and a sharpening of his hearing and reading skills before moving on to more advanced study, nor yet for the college freshman with a lively interest in popular or serious music but with little or no actual training in performance or theory. Something about the plan and scope of the book seems to say that it was designed for use in schools (grade or grades unspecified) with the aim of catching the casually interested child off-guard, so to speak, and leading him by gradual and painless stages from the singing of simple melodies to the recognition of intervals, scales, and simple chords; from awareness of pulse to a rudimentary understanding of rhythm; and from singing by rote to reading by note. There is no systematic or exhaustive study of rhythm, melody, and harmony as such. Instead, the chapters form a series of graded lesson plans, so conveniently organized for school-room use that a teacher with little or no previous knowledge of music theory should be able to keep at least one jump ahead of her class if she can read simple music, sing and play the piano a little, and follow the very explicit directions given in each chapter. A commendable feature of this course of study is that every musical concept to be taught is presented, not in abstract terms, but as something first heard in a performed musical example. The examples include many melodies from folk-songs, for some of which the authors have provided original and entertaining lyrics, plus a judicious selection from both standard and contemporary vocal and instrumental music.

This book should prove useful in any school system that aims to do more with music than merely entertain its children with a little rote singing. Use of some such approach in grades below the junior high school level might help to forestall the musical illiteracy of all too many high school students. Music schools providing instruction for children could also use this course to prepare the way for more advanced work in sight-reading, choral singing, harmony, and music history, especially in communities where the public schools provide little or nothing of comparable value.

Although I have stressed the usefulness of this book in the education of children, there is no reason why an adult who sings or plays a little might not use it to learn more about notation and get a start in elementary theory. The adult reader, however, should be warned against the oversimplification which is almost unavoidable in attempts to describe anything as complex and fluid as the practices of living music in terms easily grasped by a child. A case in point occurs in Chapter IX, where the authors use the term "power tones" to characterize scale steps 1, 3, 5, and 8. Although the term is picturesque and apparently new, it rests on the rather old and questionable assumption that the tones of the tonic triad necessarily create a feeling of finality, while all the remaining scale steps have the function of moving directly in predictable ways to these components of tonic harmony (collectively designated as "inactive scale steps" or "rest tones"). This concept, though defensible in some very simple phrases, breaks down as soon as a chord other than the tonic becomes a goal of motion, and it may therefore be highly misleading to mention it at all without point-

ing out that its applicability is extremely limited.

Perhaps I should mention one feature of style in the printing of melodies with words, one which is contrary to the custom of several centuries. I refer to the banding together of two or more eighth notes (or notes of shorter value) when each of the notes carries a separate syllable. This is a comparatively recent innovation in vocal scores, although similar groupings have long been used in instrumental music. Adopted by certain contemporary composers to facilitate the reading of rhythmically complex passages, this style seems quite unnecessary in the notation of simple melodies. If it is to be used in a book for beginners, it would seem that the traditional style of using a separate hook or flag for each short note carrying a syllable should also be shown and a reason given for adopting the newer style. The format, editing, and printing of this book are exemplary: if any errors of copying remain, they have escaped my notice.

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Bauman and Walton's Elementary Musicianship is listed as a second edition. Comparison with Alvin Bauman's book of 1947 shows that very little beyond the title has been retained. Reduced in length by 97 pages, the newer book has been almost completely reorganized and rewritten.

Although the Bauman-Walton book differs in many respects from the Katz-Rowen book, subject matter and pedagogical approaches are strikingly similar. Both proceed from the premise that the elements of music should be experienced through hearing and performance before they are isolated for study, both follow a logical but different order of presentation, and both aim to lead the student through directed hearing and action to musical competence on an elementary level. Like Katz and Rowen, Bauman and Walton mention no age-limits for users of their work, but the plan of the newer Elementary Musicianship suggests a higher age-bracket. This is borne out by the chapter headings, which read in order: Notation; The Major Scale; Keys and Signatures; The Tonic Chord; The Dominant Chord; The Dominant Seventh Chord; The Subdominant Chord; The Minor Mode; Modulation to the Dominant Key and Implied Modulation; Chromaticism; and Form in Music. A work planned in this way is obviously not aimed at the very young child but at the older young person who has reached the stage of wanting to learn something definite about the items listed in the table of contents. The presupposition of pro-musical motivation on the part of the student would seem to rule out the use of this book in the early grades of most schools. In an ideal educational system providing special training for children with special talents, a topically-organized course covering this ground might be offered well before high school or in the early high school years — if not as part of the regular curriculum, perhaps in a voluntary music club under the guidance of an inspired chorus or orchestra leader. Until such instruction becomes general in the public schools, it will have to be given in colleges and private music schools.

Although the plan and purpose of the Bauman-Walton book are to be commended, and the book is handsomely printed, the work is marred by a surprising number of loosely-worded statements in which the Eng-

lish says something very different from the intended meaning, or the idea itself is fuzzy and misleading. The proof-reading, moreover, appears to have been very hastily or inexpertly done. It is possible that I may have overlooked other errors than the ones listed below, but I can scarcely conceive of the book's fulfilling its high aims until the following items, at least, have been satisfactorily revised.

P. 22. A sample of the chromatic scale beginning on C is followed by this explanation: "It is possible to form a major scale on any of these tones by using all the black and white keys. Each one of these pitches or tones can become the key tone of the particular scale or group of tones." The first sentence is ambiguous. To say what is meant, the sentence would have to read: It is possible to form a major scale on any of these tones by using a suitable selection of black and white keys.

P. 31. The concept of "active" and "inactive" scale steps is restated in much the same way as on p. 5 of The Material Used in Musical Composition by Percy Goetschius (G. Schirmer, New York, 1907). With respect to the limited value of this classification, see comment on "power tones" in our discussion of the Katz-Rowen book.

P. 32. "We can now add 4/2, 2/2, and 3/2 to our time signatures. All of these signatures we have discovered in the music represent simple meters, since a beat or pulse can be divided by two or its multiples." It is obvious that a pulse can be divided by two — or by any other number — but what this may have to do with the preceding clauses completely escapes me. Were parts of two unrelated paragraphs accidentally combined?

P. 52. "Notice the stepwise movement of these tones and that the root is doubled in each chord which is the usual procedure when chords are played or sung." This sentence follows an example of the triads I-V-I in G major with the soprano and tenor parts moving conjunctly, the bass leaping a fourth, and the alto remaining stationary. Since the antecedent of "these" is not stated, the point is not clearly made. Moreover, it is dangerous to make a sweeping generalization about doubling on evidence as scanty as this.

Pp. 63-64. Here, where Stephen Foster's "Old Folks at Home" is quoted to provide examples of syncopation, we read: "In measure 2 the stress is on the second syllable of 'riv-er', which is normally a weak beat." This statement is poor on two counts: (1) "syllable" and "beat" cannot be equated [the last clause could be recast to read: which is normally unaccented]; (2) the statement as a whole would still be misleading, even with this correction. To clarify the meaning and explain what is involved in the principle of so-called "agogic" accent, one could say that a tone beginning on a weak beat or fraction and continuing through a stronger beat or fraction has a tendency to become accented by virtue of its lasting longer than the tone which immediately precedes it. One might even go on to mention that the higher of the two tones in a zig-zag melodic formation tends to acquire prominence by virtue of relative pitch, but to state or imply that the second syllable of the word "river," in any context other than a parody, should be sung with more accent than that given to the first syllable is to lead the innocent student into a bog of untruth. Any conductor permitting verbal distortion of this sort in a performance should be summarily pulled

from the podium! Here is a musical phrase in which every precaution should be taken to prevent special stress on the longer and higher of two tones.

P. 79. In a paragraph making the familiar (and justifiable) distinction between the "primary" and "secondary" triads of a key the authors state that the triads on I, IV, and V "are the ones most often used in music." This can be true of a particular style without being universally true. The further statement that triads on all the other degrees of the scale "serve as substitutes for these primary triads to give variety and contrast to the music" is true as far as it goes, but it can be quite misleading to imply that the "secondary" triads have no status except as substitutes.

Page 98 contains a whole series of statements in which the English says something very different from the intended meaning. The first of these, for example, reads: "If a major interval is lowered one-half step, it becomes a minor interval." This is impossible; lowering or raising any interval any distance can change the pitch of the interval but not its character or quality. The musical examples prove that the authors are trying to show what happens when the pitch of the upper note of an interval is changed while the lower note remains unchanged. Although the authors are not to be blamed for inventing the symbols which they have used for major and minor intervals — since these have been used elsewhere — the adoption of the + sign for a major interval leaves us with no convenient symbol for an augmented interval. Since augmented intervals have been traditionally symbolized by +, and diminished intervals by ^{o}, it would be more practical to use M as the symbol for major, and m as the symbol for minor, intervals.

P. 142. In a paragraph pointing up the distinction between a parallel period and a repeated phrase, it is stated that "the melody must be the same in a repeated phrase; the harmony can be the same or different." If it is granted that a phrase can be recognized as a modified repetition when its melody remains and the harmony is changed, what is to hinder similar recognition when the harmony remains basically as it was and the melody is changed?

Occasional misprints are to be expected, but I was astonished to find as many as these:

P. 23. Signature of C^{b} major in the bass (A^{b} instead of F^{b}).

P. 26. Fermata sign instead of a tenuto dash over a dot indicating separation.

P. 33. Bar 2 on the third staff apparently has a superfluous quarter note.

Pp. 34-35. The second, third, and fourth staves have one sharp too many in the signature.

P. 36. U.S. Army mess call. Not the official version, if my memories of 1917-18 are correct. Bars 2 and 4 seem to have the wrong rhythm, while bar 3 is a third below pitch. What kind of hash would the hungry service man expect after hearing the given version?

P. 38. The signature of melody #15 apparently has one sharp too many.

P. 46. In melody #49 the second note in bar 4 should be E^{b} instead of D.

P. 47. Melody #53 is the same as #35.

P. 69. Bar 2 on the second staff has an unwanted dot, and a bar-line is omitted on the second score of melody #17.

Pp. 83-84. Melody #14 apparently has one sharp too many in the signature.

P. 139. "Fuoro" should read "fuoco."

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Murphy and Melcher's Music for Study is not, strictly speaking, a textbook but a "source book of excerpts" as the sub-title indicates. The authors' aims are well stated in the following quotations from the introduction:

> This source book has been compiled to meet the recent trend toward basing all types of theoretic instruction upon real music. The selection of the music was governed by a number of factors, among them the harmonic and formal content, variety of media, structural significance, stylistic characteristics, aesthetic appeal, availability, and ease of performance. The material is designed to parallel the harmonic vocabulary of college theory classes, and hence is selected chiefly from compositions of the eighteenth and nineteenth centuries. Furthermore, meaningful passages rather than isolated fragments were chosen.... The material is arranged in accordance with general teaching practice rather than in agreement with any specific harmony text. Therefore, it can be used with a wide variety of texts and of teaching situations .... No chorales are quoted because it was felt that such material is readily available.... Since this is a source book, it contains no expository material.... The uses of the material in this source book are varied and flexible. Essentially, the book provides examples for classes in harmonic, formal, and stylistic analysis. It is equally useful in providing material for classes in written and keyboard harmony, music reading, and ear-training.

Since it would be impossible to cover the entire field of music in a single collection of examples, the authors have necessarily excluded certain periods and styles — notably pre-18th-century polyphony, extreme chromaticism, and everything more recent. Within the limits set by the authors, they appear to have made a useful selection of samples. Almost any teacher may wonder why some favorite example is missing or why some example chosen by the authors does appear, but one must admit that it would be impossible to make any selection that every teacher would wholly approve. If I were still engaged in the teaching of harmony and form, I am sure I should find an abundance of valuable illustrative material within this book. A colleague who used this source book during the summer of 1960 confirms my opinion as to its probable worth. Although he has spotted a few misprints, he assures me that the proof-reading on the whole seems to have been carefully done.

H. LEROY BAUMGARTNER

THE MUSICAL QUARTERLY. SPECIAL ISSUE: PROBLEMS OF MODERN MUSIC. Vol. XLVI, No. 2, April, 1960.

If readers of this journal do not already have at hand the April 1960 issue of The Musical Quarterly, my initial comment must be directed to them and may take the form of brisk advice: get a copy. Its cover page suggests all the recommendation that I believe should be necessary: "Special Issue: Problems of Modern Music; The Princeton Seminar in Advanced Musical Studies." The contributors: Milton Babbitt, Elliott Carter, Edward T. Cone, Allen Forte, Ernst Krenek, Roger Sessions and Vladimir Ussachevsky. In addition, Paul Henry Lang has provided an introductory editorial, and Paul Fromm describes the genesis of the idea of the 1959 Seminar (the Fromm Music Foundation helped to make it possible) as well as its general purpose and present plans for the future.

Having said that much, I find myself committed to a very peculiar duty. Not the necessity of writing about music — which in itself is a fairly peculiar activity — but, of all things, verbalizing about verbalizing about music. The process seems to me to be very similar to, say, eating a photograph of a painting of a lamb chop. That way lies, not necessarily madness, but very probably malnutrition. And — to bring the analogy to its terminal point — the material under discussion here is medium rare.

As everyone must realize by now, the present relations between the composer, the composed music, the music not yet composed, the discussion of music composed and not yet composed, the theorist, the popularizer and the consumer of both the central and peripheral items — this complex network now operates in a way that is apparently free from anything approaching historical precedent. A single illustration characterizes the situation adequately: there is today more than one composer who — in the terms of the trade — has a "firmly established reputation" on the basis of words, words, words; even where (perhaps especially where) not a note of his music has ever been heard or seen. The point, then, is that communication theory has manifestly arrived just in time, for odd things may be happening, and any potentially powerful source of illumination must be welcomed. Unless, that is, we no longer find grounds for curiosity about a new hierarchism in which the manifesto is to outrank the music.

It is just such curiosity that draws me again and again to a particular sentence in Mr. Allen Forte's contribution to the present group of essays. (An analytical study of the third movement of Bartok's Fourth String Quartet, the title of his paper, "Bartok's 'Serial' Composition," indicates the route chosen for the occasion by my good friend Mr. Forte.) The sentence exercising hypnotic command of my attention is this one: "Because of Bartok's reluctance to discuss details of compositional technique, we are left in doubt as to the precise extent of his knowledge of serial procedures." Now I am not prepared to argue that in reality this constitutes the magical proposition I am making it out to be — especially given the relevant date (1928) of the piece under discussion. I am in fact aware that musicological studies of all kinds will now and then invoke substantially similar utterances. Neither is it so

much a matter of agreement or disagreement with the expressed idea, nor am I even certain that I can make clear just why I believe that an appropriate commentary on that sentence could fill a volume, and that the volume would define the current mental outlook with great precision. But somewhere near the heart of the matter is the implication — or, let it be the inference that we draw, rightly or wrongly — that the degree of meaningful information we may possess with regard to a composer's awareness of technical concepts and processes must in any way depend on what he himself tells us: in words.

High on the list of my personal eccentricities is the insistent, indeed flagrant and final, conviction that that is not so. I shall not run down my list here, nor even advance supporting polemics for the sample provided, but it is clearly to the point to add the following zealotisms: (1) the essential value of musical analysis is for the person who undertakes it, since it is a form of exercise in thinking about music, and the direct benefits of exercise are not diffusible but are (alas! for the lazy) restricted to the exerciser; (2) since, on the other hand, an onlooker who wants to may perhaps learn something of this kind of exercise by being shown what to do and how to do it, there is ordinarily little occasion to demonstrate — even assuming it is demonstrable — that, say, wiggling the toes may strengthen the wrists (cf. theorist after theorist looking at the Renaissance via criteria of the Baroque; cf. Hindemith looking at "non-tonality" via criteria of "tonality;" cf. Forte looking at "non-serialism" via criteria of "serialism"); (3) without for a moment engaging the question of Bartok's significance, or the basis on which rests Mr. Forte's personal response to that question, the treatment of what can fairly be called in 1960 "problems of modern music" tends to require some other focus of consciousness — be that or not an individual composer and/or work.

On the latter, clearly related, items, I own up to an awareness of the arguments for the in-the-light-of-our-experience essay. But in the admittedly unpopular and, until today, thoroughly un-Germanic, attempt to grasp historical disconnection — the so-called "new historicity" relating its views to our by now familiar esthetic terms: "the discrete instant" and "the pointillistic," and, as might be expected, to the old quantum theory analogies — it is perhaps there that much new light on our experience may be shed. Not, of course, "perspective" where none exists; but then, also, not the "perspective" which must, unnecessarily, distort both the object viewed and the viewing mechanism.

The point recurs in the course of the present discussion; with particular distinction where Mr. Milton Babbitt's paper is seen to introduce a most pertinent and handsome delineation of the kind of outlook I am endorsing. At present, unfortunately, I take leave of Mr. Forte's article, having rendered it a disservice by not displaying its substance: indeed by so trivial a reference to so elaborate an exposition —a reference, moreover, to what is manifestly of little significance within that exposition itself. My three conscience-ridden excuses for such dereliction of duty, and for its subsequent extension to the treatment of other papers in the group, are: (1) anybody who is very interested in what I am saying here will surely have had, and perhaps

still has, a copy of the special issue near his desk: (2) he will therefore realize that re-exposition in my words of the author's own expositions, though a procedure reflecting the wise policy by which reviewers for this and other journals ought ordinarily to be guided, would in the present instance tax both my readers and myself inordinately and unnecessarily — "inordinately" since we may temporarily assume that in each case an author evolved the most clear-cut possible statement of what he had to say (an assumption I intend to do without come a few paragraphs from now); (3) "unnecessarily" since if the special issue has been mislaid, the minimal cost at which the copy is obtainable represents an excellent investment.

To return to the matter of analysis where do-it-yourself kits are being proposed to, and in a growing number of cases being eagerly snapped up by, contemporary composers: Mr. Edward T. Cone's article contains an interesting parenthetical aside, which is here of course taken somewhat out of context. It runs as follows: "If we are lucky, the composer or one of his initiates will spare us a lot of hard work by supplying us with the key." As soon as that statement is returned to its own frame of reference — which I shall undertake to do in a moment by quoting from the relevant surroundings — it becomes clear that there is a critical relationship wherein the possible irrelevancy of some chosen analytical method, or, as later develops in Mr. Cone's case, the suggested unconditional withdrawal of analysis altogether, is directly linked to this notion that the composer himself had better provide an authorized verbal version of the subterranean shenanigans. For what has brought Mr. Cone to a dilemma that for any analyst is liable to be less than soothing, is the fact that he cannot analyze a good deal of the music being written today. And, as it happens, he asserts that, therefore, this music does not permit of analysis. That is, "when chance plays the major role," or "where improvisation is given such free rein that it actually creates the form of the work anew at each performance" — Mr. Cone's fairly debatable characterization of Stockhausen's Klavierstück XI — or with "music written according to a strictly predetermined constructivistic scheme, such as Boulez' Structures" — under any and all such conditions, Mr. Cone submits that analysis "cannot apply." The question arises at once as to whether, then, the title of his paper, "Analysis Today," is not more misleading than it need be. Simply on the basis of the article's illumination of "certain types of composition in vogue today" — the illumination and the "types" in question are defined by the preceding quotations — something more like "No Analysis Today" would come closer. And, aside from a piano piece of Sessions (possibly written long before the publication copyright date of 1947), the Webern Piano Variations (1936) is the most recent of the works discussed in some detail in the article. Mr. Cone's views on the first twelve measures of the last movement of that work reflect an admirable musical intelligence, but the truth is that the point of departure is "Analysis Yesterday," certainly when we consider Webern studies that have recently appeared elsewhere.

Now I am afraid I have given an unfortunate picture of Mr. Cone's contribution, which is in fact a thoughtful product of serious musicianship. But if composers throughout the world are today preoccupied with modes of musical thought which are for Mr. Cone "far afield from

the practical considerations that are our concern here," we must speculate on whether such considerations are indeed practical, or whether they are not merely "convenient" in quite another sense. They are clearly impractical enough to lead to formulations of this sort: "The connections are mechanistic rather than teleological: no event has any purpose - each is there only because it has to be there." (I need not again identify the alleged compositional procedures to which reference is made.) Putting aside questions relating to the degree of accuracy in Mr. Cone's description, it is manifestly an impractical view of "teleology" that holds that an event occurring because stipulations require that it occur is an event without "purpose." There is a kind of circular contradiction within Mr. Cone's statement that I feel certain he would not have permitted had he not been seeking to dismiss what "practical considerations" might just as well have led him to embrace.

I can imagine no bias more practical for the analyst of music than to assume from the beginning that newer ways in the "putting together" make mandatory newer ways in the "taking apart." The trick is not the analysis proper; it is in the searching for, and in the choosing, rejecting, sorting — in short, in the finding — of the appropriate analytical tools. For if you are measuring things and your measurement techniques do not measure, you do not have on that account a proof that the things cannot be measured. You have merely shown that your own analytical apparatus is inefficient. Mr. Cone all but nails down the point briefly and distinctly, observing that it is, as he says, a crucial one: "The good composition will always reveal, on close study, the methods of analysis needed for its own comprehension." I must of course resist asking whether it is only the "bad" composition that has to be accompanied by its composer's exegesis. But value judgments aside, when music analysis sets its own terms and concepts strictly and independently, there is a distressingly excellent chance that it is analytical method itself turning into, and operating as, what Mr. Cone identified in another connection as "a strictly predetermined constructivistic scheme."

It is therefore pertinent to cite Mr. Cone's rejection of the notion that "analysis can demonstrate the quality of a work." For what is still "in vogue today" is the complex of ideas maintaining — by an abundance of implication — that to value music highly is to "understand" it, which means to "analyze" it, which means to fit it into that college catalog entry bearing the euphoric caption "Form and Analysis." It is not necessary to elaborate here on the fine old saw of Raphael that Stravinsky spoke of some years ago: "to understand is to equal." But it is invariably worthwhile to reflect on Schopenhauer's (I think it was his) elegant judgment on analytical judgments, to the effect that when ideas come into contact with a head and an empty sound is heard, the question of whether the emptiness resided in the ideas or in the head (I am presumptuous enough to add: or both) merits a certain deliberation.

What is still more in vogue today is the nerve-wracked inability to confess ignorance about anything — and perhaps worse, the immediate consequence of that inability: play-acting that wants to believe, and to have us believe, that either the thing or the ignorance does not exist. The ironic relation of this state of affairs to the layman's awe of

"science" is, in turn, by no means irrelevant to current musical discussions. And the conventionalism of that state of affairs, of that awe and those discussions, is distinctly opposed to the spirit of inquiry in the actual domains of rigorous thought. I recall the philosopher C. D. Broad having written somewhere that we have in fact come upon originality when we at last find a man who regards ignorance of a mode of thought as a first-rate reason for not explaining it to others. Which points up the fact, by the way, that perhaps the most radical deviation from the norm in the various contributions under discussion here is represented by the following model of intellectual honesty, from Mr. Paul Henry Lang's editorial commentary: "We do not profess to be able to follow Mr. Babbitt's disquisition beyond a very modest degree, but since it comes from an unquestionably competent and dispassionate source, and has undoubted relevance to the problems under discussion, it will prove enlightening to those versed in the mathematical systems presented, which are absolutely beyond the ken of the Editor of this journal."

By definition, the originality depicted by Mr. Broad and exemplified by Mr. Lang — and ringing through Einstein's classic: "Since the mathematicians have invaded the theory of relativity, I do not understand it myself any more" — such originality will not exist where bare conceptual shelves are stocked with the opulent glossaries of nondigested cybernetics, parapsychology, wave mechanics, and God-knows-what-else. It is at this point that almost all the articles of the special issue — I am tempted to say almost all the articles of all the special issues here, there, everywhere in recent years — must be "congratulated" on the "modernity" of the prevailing linguistic temper. For we find that even trivialities (which after all occur in the most exquisite discourse) are now locked into a new tightly sealed philology by the new non-philologist. I suppose that a man of science whom I know is right when he tells me that the popular notions of "objective thought" and "scientific method" have admiringly identified those things with jabberwocky and paralysis of the imagination; and the layman acts accordingly, leaving only the "objective scientist" free to express opinions. But that is aside from the point. The point is that those for whom words about music are (apparently) to take on major significance must set their verbal houses in far better order than they have been able to do thus far. Tautology in itself is not necessarily fruitless — I would suppose that mathematics represents a most illustrious proof of that — but the substitution for simpler verbal symbols effected by very much more complex ones does not automatically yield any keys to any kingdom. It is in fact usually accompanied by an equally fallacious conceptual counterpart: mistaking the symbol for the thing it symbolizes, which is always on the verge of happening in the newer musical thought in general.

I cite no cases; the reader who wishes to and is unable to locate any for himself will of course simply disregard the matter entirely. For my own part, I consider it "substantive" since I choose to think that I am committed here largely to writing about writing. With the indescribably light conscience of one who neither possesses nor claims to possess credentials appropriate to literary criticism, I point out that in the matter of gifted writers the new writing about new music seems

a wasteland when compared with what can be located in areas of mathematics and physical science. For instance, we have no erudite masters of the art — or craft, or science, or whatever you like to call music — who are at the same time brilliantly lucid in dealing with (admittedly difficult) technical aspects of the subject. In this regard, the unlimited virtuosity of, say, Schrödinger or Eddington, of Laplace, Poincaré, Whitehead — to choose at random from a veritable embarras de richesses — such gifts are manifestly beyond the power of writers on music. Nowhere is there aroused "an intoxicating delight in intellectual clarification," such as Bertrand Russell spoke of in describing his own reaction to the writings of William Clifford. For nowhere is there to be found what Russell further called "an art of clarity . . . not the pseudo-clarity of the popularizer, which is achieved by ignoring or glozing over the difficult points, but the clarity that comes of profound and orderly understanding, by virtue of which principles become luminous and deductions look easy." The Olympian art of rendering comparatively difficult ideas accessible remains a lost art; the standard literary technique for musical discussion becomes, instead, the simple-minded one of converting comparatively accessible ideas into an impenetrable opacity.

But the difference between the counterfeit and the real thing is easy enough to discern. For very often when writings on music proceed from what is (indiscriminately) called "scientific attitude of mind," the reader will at once detect very little science, considerably less mind, and, therefore, an attitude appropriate to what William Carlos Williams might call "knowledgeable idiocy." It is not to the present point to look into the question of red-eyed and stale-minded quackery; the matter is mentioned here merely in order to remind the reader that what is in fact unique in our domain is the formulation of truly rigorous thinking by a truly rigorous thinker.

I imagine it would be superfluous to comment on the kind and degree of intellectual power that Mr. Milton Babbitt brings to musical discussion. Nor should it surprise anybody familiar with his previously published studies and reviews to find that Mr. Babbitt's contribution to the present anthology is a model of conceptual strength and accuracy. By now it is an old story that his mode of verbal expression must often appear to be exotic — in the root meaning of that word: "outside" — since the degree of meaningfulness he achieves in the correlation of Precise Idea and Precise Word is extraordinary; hence it is generally "outside" the range of capabilities of writers who deal with the same and similar subjects; hence it is "outside" the range of experience of a majority of readers.

While the present paper, "Twelve-Tone Invariants As Compositional Determinants," constitutes the general inquiry its title implies, an exposition of very concrete particulars makes up the main body of material. Perhaps the most basic and perspicuous of these concerns the fundamental defining characteristic of twelve-tone concepts and processes: "Any consideration of the operations of the system must proceed from an awareness of their permutational nature." Although contemporary musicians might be expected to intuitively sense the historical disconnection between "a permutational system (and) the

combinational systems of the past," I believe it is of great value at the present time to again affirm the existence of the disconnection, for the "evolutionist" doctrine so frequently brought into this area wants to obliterate a musical reality for the sake of an armchair philosophy and its vision of commodious continuity in artistic events. The distinction between fortuitous similarities and teleological standards would seem to be immense and unambiguous; nevertheless, the sort-of-nothing-but kind-of school of musical "analysis" remains densely inhabited.

In this regard, it occurs to me that were I granted dictatorial powers I think I would at once banish almost everybody who emphatically relates a pedal-point situation (or anything else) in Bach to "polytonality," or the subject of Fugue No. 7 in W. T. C., Vol. I (or any other) to "panchromaticism," or, conversely, for instance, Schoenberg's String Trio to "unresolved appoggiature," and so on. Not that I stand unalterably opposed to analogues: I might in a genial moment permit a discourse on (say) talea and color to qualify, though only modestly, the possible inclusion of isorhythmic constructive principles in Mr. Babbitt's broadly generalized reference to "combinational systems of the past." But the norm would be the firing squad for anybody who, in outlining what constitutes "historical imperatives" allegedly conditioning the approaches to Schoenberg's Op. 23/5, managed somehow to deplume the exclusivity of the first four pieces of that set and/or the preceding works of the same composer. The immediate purpose of my utopian autocracy would be to reawaken in what a friend of mine calls "our communality of blab" the languishing gift of being astonishable. One immediate result would of course be that the astonishing conceptual originality of Schoenberg's method would in fact, without modifying reasonableness, astonish. But in lieu of the necessary authority with which to carry out this pleasant program, I must merely express agreement with, and admiration for, Mr. Babbitt's elegant commentary on the central historical issue.

The specialized agenda to which the paper is addressed embraces, among other things: numerical notation, "compositional hierarchization" of the transposition of sets, rigorous outlining of the basic quasi-geometric manipulations characteristic of twelve-tone methodology, criteria re the notion of "basic (original) set" in empirical circumstances, and, throughout, close examination of related matters. "Related matters," that is, so far as pitch-class, interval-class and ordinal arrangements thereof (without further stipulation re pattern of occurrence) are concerned. Therefore care must be taken not to impute extraneous implications to the title; and in this regard, attention to the significance of the word "as" should minimize the possibility of erroneous inference. For Mr. Babbitt is not discussing "compositional determinants" in general, much less evaluating their (conceivably) rival claims to constituting some supposed matrix of morphology.

Nevertheless, in his closing paragraphs Mr. Babbitt touches on the question of "generalized" serialism and its intimate connection with the subject matter of the paper. It is imperative to mention here that about fifteen years ago Mr. Babbitt was composing music in which what is currently named the "newer serial thought" was already operative — that is, a music revealing the extension of such stipulated ordinal con-

trols as characterize twelve-tone usage to elements other than pitch. I say it is imperative to mention this not only because readers of the present review are very possibly unaware of that circumstance, but — more relevantly — because Mr. Babbitt's concluding argument might otherwise seem less pertinent than it is. Whether or not one can oppose to it other, equally powerful arguments is not the point here. With the fairly widespread misconceptions about the nature and purpose of serious speculative thought in the domain of the newer music, and with the prevalence of habits of mind receptive to the fabricators of Miss Rheingold of this year or Mr. Darmstadt of next (as the case may be), it becomes necessary to emphasize that where Mr. Babbitt's remarks imply a certain querulousness on his part, and, for that matter, a set of personal values in general, they do not proceed from a posture that is either passive or avuncular.

I have already hinted at the nature of the project confronting those readers of Mr. Babbitt's paper for whom ideas remain incommunicable when expressed in terms other than those of the everyday undefined language basis. Let it be understood at once: a non-mathematically inclined musician will have his work cut out for him; but if it is any consolation, it seems very probable that a non-musically inclined mathematician cannot hope to have even the foggiest notion of what the substance of the proceedings represents. In fact, the "mathematics" involved resides in the mode of thinking: a matter of applied concept and terminology — which is to say, as Mr. Lang pointed out, it is accessible to the degree that the modes of thought (as opposed to applied skill) are accessible. I would go so far as to suggest that there are some definitive advantages for those with very limited practical mathematical finesse. (For instance, a minor misprint re the arithmetical notion of congruence will, for such readers, remain conveniently outside the field of distraction.) But these things are to be considered: that, in general, conscientious writing merits conscientious reading, and, in particular, that a manifestly powerful contribution to contemporary theoretical literature — one which deals with a root matter in contemporary musical literature — is under discussion here.

Perhaps because Mr. Babbitt has adhered so closely to the policy of thinking through what it is he has to say, and saying only what he has thought through, his contributions to music journals appear relatively infrequently. And it may be for the same reason that they invariably seem so rich in substance and disciplined in manner, constituting — in my own opinion — some of the most reliable reflections of an unimpeachable quality of mind that such journals can hope to project.

While Mr. Babbitt's paper is in every sense as "pure" as pure theoretical exposition is wont to be, there are in the present anthology two no less refined instances either of which is quite capable of shaking an unshakable bias against composers' analytical discussion of their own works. For Ernst Krenek and Vladimir Ussachevsky, in addressing themselves to methods and principles of organization conditioning pieces they have composed, have endowed the present collection of essays with the material that is clearly most relevant — all things considered — to immediate "problems of modern music." Criteria for this statement may readily be located in the respective titles: Mr.

Krenek's "Extents And Limits Of Serial Techniques," and Mr. Ussachevsky's "Notes On A Piece For Tape Recorder."

The scope of the former can be indicated by merely listing here some of the sub-headings in the article: The Principle of Rotation; Rotation and Time; Serialism in the Electronic Medium [where now the composer is being scolded for not doing better with verbal explanation: "Unfortunately the presentation by the author (i.e., Stockhausen's analysis) is not always felicitous, so that some of the intricacies of his work (Elektronishe Studie I) remain obscure."]; Premeditated, but Unpredictable; The Element of Chance (this and the preceding should be examined closely with regard to the contention that analysis does not operate in such domains); Layers and Densities; and, at the close: What Does Serial Music "Mean," if Anything?

My disinclination to discuss Mr. Krenek's discussion in any detail has to do with the fact that especially in this case it is a matter of either all detail or nothing at all. The former is obviously out of the question here, and the only conceivably useful comment I may make for present purposes will have to take the form of a succinct evaluation of the paper: an orderly treatment of topics which are of prime interest to the contemporary musical mind.

It happens that Mr. Ussachevsky's contribution can be characterized still more succinctly: wonderful. It is quite literally full of wonders, not the least of which concerns its manner of conveying an admirable stock of information with such ease and lucidity that (at last!) the reader may remain unaware of what an amount of knowledge and experience is reflected thereby. Mr. Ussachevsky has of course often written on the subject — his writings include some of the best (i.e., most precise and trenchant) general outlines of theories and practices in electronic media — and this little "program note" takes a place in what I hope will be his continuing enhancement of the literature.

Neither Roger Sessions' nor Elliott Carter's paper constitutes an intensive study of specific technical matters — although Mr. Carter, in the course of what appears to be a transcription of a question-and-answer lecture, discusses procedures in his own work. I happened to read these essays last of all, and I note that a formerly developed and habitual pleasure in reading Mr. Sessions was intensified on this occasion ("Problems and Issues Facing the Composer Today") when I reached the following assertion of a point that I have been belaboring here more involutedly and less eloquently: "One cannot insist too strongly or too frequently that, in the arts generally and in music in particular, it is only productions that really count, and that only in these — music, written or performed — are to be found the criteria by which ideas about music, as well as music itself, must finally stand or fall: not the converse."

Mr. Carter's "Shop Talk By an American Composer" adds a footnote to the theme: "That a composer can write music that is thought to be of some interest is, of course, no guarantee that he can talk illuminatingly about it." And Mr. Carter speaks of the peculiarity (mentioned here earlier) of the new "intellectual publicity," as he calls it, whereby "recent composers . . . have gained renown by circulating descrip-

tions of their systems even in places where their music was not known." But aside from all this, the paper is the one completely "personal" statement, in the best sense of a word forced into quotation marks by its having become suspect in the minds of fools. I think that to fully appreciate what is in Mr. Carter's paper one must know of a wider world than the one we are so used to talking about: one must know something of what was meant when men of letters spoke of the peculiarly "American" loneliness; something of how certain strong large sentiments become less "sentimental" than the immature "anti-sentimentalism" of sophomores who are only now discovering the surface residue of the esthetics of fifty years ago; above all, something of the tragicomedy it is to be a composer here and now. And if it is possible to remain impervious to the warmth of Mr. Carter's document, a "steady state" has indeed arrived.

In viewing this special issue as a whole, it is perhaps not necessary to speculate on whether, or in what way, the eidolon of Die Reihe may have enacted an off-stage role in the present proceedings. There is all but concrete evidence in various remarks of Mr. Lang, Mr. Fromm and the others that something of the sort might bear discussion — even, conceivably, in terms of a cause-and-effect relationship. For it is probably a truism by now that in mid-century matters of this kind Stockhausen's periodical got there either as the very first or with the very most, or both; and by the time the rest of the world had looked around and about (i.e., several years later), the pacemaker, in the nature of things, had turned into the "thematic catalog" and standard of reference.

But I leave that question as it stands, without debating whether the narrower field may produce (or be produced by) the sharper focus; whether opposition to dogma — for all the nobility of its gemütlich "liberal arts" humanistic tradition — may not itself sometimes become a form of dogma; and whether the existence of some American periodical designed to take up the functions of the mourned Modern Music would not render — should not have rendered — the raising of the question (indeed, with due respect, the present "special issue") unnecessary.

What I feel is well worth mentioning, however, is this: there is not in the collection of essays a treatment of what many of us are coming to identify as the paramount issue in this area, the crucial "problem" of modern music — technical, theoretical, what you will. I am referring to psychoacoustics and its range of inquiry, directed by attempted "correlations" of "the two realities." I can best explain what I mean by arguing that ingenious artifices of a composer — any composer — amount in themselves to child's play: if they are not seen as such this morning, they will be by tomorrow afternoon in almost every semi-bright classroom. That is not to gainsay their "relevance" (the reader may assume that I am not here, in one thrust, disprizing the two staples of my personal professional activity). The question is: relevance to what? The answer must be that they are relevant only to trivialities until we have started along the road — somewhat less inaccessible nowadays — that leads to the sense-fields. For, I repeat, the talk of what is "objective reality" in the matters of choice, chance, and

manipulation, is closely bound, especially today, to trivia — semantic trivia, arithmetical trivia, musical trivia — and must remain so where modes of pattern-making and modes of pattern-perceiving are, for convenience or whatever reason, dissociated from a non-dissociable interplay.

But I have in any case expressed myself badly unless I have already made it sufficiently clear that the number of musicians with nothing to learn from this special issue of The Musical Quarterly cannot exceed zero in an intelligent professional community.

MEL POWELL

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LETTERS TO THE EDITOR

In the "Theory Forum" of the April 1960 issue of the Journal of Music Theory, Ernst Oster writes a highly polemical and impassioned article about Roy Travis's "Toward a New Concept of Tonality (?)" which appeared in the November 1959 number of the Journal. Ernst Oster, staunch defender of orthodox adherence to Heinrich Schenker's concept of theory, takes exception to Roy Travis's way of applying Schenker's ideas to classical and contemporary musical structures. It is not the purpose of the following remarks to discuss the merits of his argument.

However, Ernst Oster extends his field of controversy by attacking other writers on theory for having either used Heinrich Schenker's ideas without giving him appropriate credit or for having departed from his principles without informing the reader of the exact points of departure. Ernst Oster singles out for special attack Felix Salzer's book Structural Hearing (Charles Boni, New York, 1952) to which he devotes a whole paragraph.[1]

This paragraph, as short as it is, teems with inaccurate statements. In an article in which Ernst Oster repeatedly appeals for correct scholarly procedure, this accumulation of inaccuracies, half-truths, and misquotations is truly astonishing. One doubts that Ernst Oster has made an effort to grasp the meaning of the book he undertakes to criticize. It is the purpose of the following remarks to set the record straight and to show the vast difference between Salzer's book and Ernst Oster's description of it.

Structural Hearing, according to its author, aims at molding "[Schenker's] concepts into a workable, systematic approach for use by teachers, students and performers...." Ernst Oster has the temerity to place Salzer among those who "belittle" Schenker. Moreover, he alleges that Salzer, in an unscholarly way, gives "only token credit" to Schenker.

The inquiring reader will, to his amazement, find that, far from belittling Schenker, Salzer has not only solemnly dedicated the book "To the Memory of Heinrich Schenker" but has devoted more than two pages of his Introduction to a statement of gratitude and admiration for Schenker's historic achievement.

Ernst Oster further accuses Salzer of attempting to suppress the publication of Schenker's original writings in favor of his own. He pretends that Salzer "on page xvi, comes out strongly against an English translation of Schenker's books." This assertion is completely untrue. Nowhere in Salzer's book can one find a statement to that effect. The truth is that Salzer has stated that for the pedagogical purposes of his own book he has decided to refrain from the task of translation himself. He has in no way tried to dissuade or prevent anyone else from undertaking it.

Ernst Oster alleges that Salzer "tries to justify this standpoint by

1. See Journal of Music Theory, April 1960, bottom p.86.

implying that Schenker's own interests would be served better if his diffuse, unsystematic writings were withheld from the public and replaced by a clearer presentation of his teaching, namely by that of Salzer." (!) Nowhere in Salzer's book does even a faint suggestion occur that Schenker's writings are "diffuse, unsystematic" and that they should be withheld from the public. The closest scrutiny of Salzer's book could not reveal any such implication. Salzer speaks of the very complex evolution of Schenker's concepts during his lifetime, as other authorities on Schenker have also done, and he states that "to the musician still unfamiliar with his work his publications do not present a systematic development from rudimentary ideas to their final form and definition." (Emphasis mine.) This is something totally different from Ernst Oster's allegation that Salzer has called Schenker's writings themselves unsystematic. The word "diffuse," invented by Ernst Oster, simply does not occur in Salzer's text, nor does any other word of similar connotation. The fact that Salzer has nowhere come out against the publication of Schenker's works automatically disposes of Ernst Oster's incongruous and far-fetched comparison of Salzer with Hegel and Schopenhauer.

An issue referred to in the second paragraph of this article needs clarification: Salzer's departure from Schenker orthodoxy and Ernst Oster's reaction to it. Salzer, in his strongest tribute to the universal validity of Schenker's concepts, has explained in the Introduction to Structural Hearing why he decided to apply Schenker's basic ideas to widely diverse musical styles, which Schenker himself has not done. As Salzer expresses clearly and in great detail, the wider coverage of musical styles which he undertakes is one of the principal reasons for his revisions and attempts at new developments of the original theory. Salzer, indeed, devotes an important part of his Introduction to the question of the expansion of Schenker's concepts and he in no way shirks his scholarly obligation to justify the changes he introduces in Schenker's original work.

Ernst Oster, on the other hand, gives the impression to the naive reader that Salzer, dealing in cavalier fashion with the problem of modifying Schenker, dismisses the issue perfunctorily with three words: "certain definite modifications." Disregarding the context of Salzer's two hundred-odd words, Ernst Oster wantonly pulls out these three!

The reader is urged to examine the Introduction to Structural Hearing to uncover the truth.

On the point raised by Ernst Oster, that Salzer failed to state specifically where he deviated from Schenker, very little need be said: In Structural Hearing the examples of musical styles not dealt with by Schenker are numerous; so are, necessarily, the deviations. No author who has so unequivocally given his reasons for modifying Schenker is obliged to account for every single departure from dogmatism and orthodoxy.

Hans Neumann

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